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A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 103 NEW YORK, DECEMBER 12, 1929 Number 24

Flood-Control Changes

THE first definite statement that work on two of the proposed Mississippi floodways is to be held up pending further engineering investigations is contained in the President's message to Congress. Some time ago the President put such a proposal up to the Congressmen from the districts in which the floodways are located, advising them that he would hold up the work if they would agree among themselves to ask for it. This was temporary action. His statement in the message now makes it certain that the much needed engineering restudy of the Boeuf and Atchafalaya floodways will be made. The President also recommends to Congress an increase of $5,000,000 in the appropriations for Mississippi flood-control work, bringing the total available for the next fiscal year up to $35,000,000. The recommendation is sound, as such action will give better opportunity to take full advantage of the splendid construction plant which has been developed by the forces working along the river.

Federal Power Control

CHANGES in the set-up of the Federal Power Commission have been recommended to Congress in the message. The President believes that the three members of his cabinet who now make up the commission are too much occupied with their regular duties to give the proper amount of attention to the administration of the federal power act, and he suggests that a commission be set up whose principal duty will be the administration of the act. Few will doubt the wisdom of this proposal. Up to now, partly through lack of funds and partly due to the way in which the federal power act has been administered, the act has not brought about the results which were expected of it. Each year the situation grows worse, because each year brings more and more records of cost of water-power development to be checked and new broad problems of administration, demanding the attention of a continuing administrative body. The field is one in which prompt action is needed, and it is to be hoped that Congress will support the President's view. If the right sort of men are found to serve on the commission the change should go far toward creating an effective organization.

Interstate Power

AMONG the problems which the President would put up to the new power commission is that of providing a means of controlling the rates charged for power exchanged across state lines. These rates cannot now be adequately controlled by state utility commissions. Not that the President would take control out of the hands of state commissions; he would simply have the federal commission act to co-ordinate the work of the state commissions in all cases which concern two or more states. Some means of providing adequate control of power generated in one state and sold in another is greatly needed. In some instances co-operation between state utility commissions will serve, but in many it will not, and in no instance is there a simple way of bringing such action about. Federal legislation can make such interstate action feasible. The National Association of Railroad and Utilities Commissioners has had the matter under consideration for some time, but it can only advise, it cannot inaugurate action. If the Federal Power Commission is made a clearing house for such matters, with positive instructions to act only in case of disagreement between state commissions, the present unsatisfactory situation can be cleared up. This is further reason for reforming its make-up.

Steady and Well-Balanced Growth

IN A forceful essay warning against an attempt to initiate a new business boom our contemporary *The Business Week* observes that "it is high time that we recovered from the mania of smashing records or hitting new highs and acquired a wholesome respect for steady and well-balanced growth." We emphasize the last words, for they are transcendentally important. To lead and stimulate such recovery and growth is the great function of the industrial and commercial leaders whom the President gathered together at Washington last Thursday to further his efforts toward maintained stability of business. They were called, it turned out, not to advise the government or to be advised by it; not to consider whether unemployment can be prevented by an expansion of public works; but solely to review the working program of private industry and convince one another and the folks back home that it contains no reason for reduced production, consumption or exchange. Their discussions contained many hopeful words and large figures. They were natural and proper. But when the press reports of the meeting converted them into a chorus of prediction of new-high-record business, the result was less commendable. Now that the captains and kings have departed there comes to memory most strongly the President's introductory suggestion to the meeting: *to go to work*. Propaganda is not needed, nor is feverish acceleration of activity desired. The times demand nothing other than steady and well-balanced growth, that growth which our natural needs require and which is excellently expressed in the construction program already outlined for the coming year.

New Welding Development

SEVERAL months ago, when the gas-welded building at Niagara Falls was under construction, we commented upon the importance to the structural art of having gas welding grow as a parallel development with arc welding. In this issue is presented the first complete account of the design and erection procedure used on the

pioneer gas-welded structure. This will be followed next week by an article on the fabrication methods, including the revamping of existing facilities necessary to fit the shop and its personnel for welding work. Taken together, the two articles form a contribution of unusual practical value, demonstrating ways and means of adapting a new tool to the needs of the structural designer and the fabricator. Many of the suggestions advanced are equally applicable to arc welding, for experience has demonstrated not only that both the gas- and arc-welding processes are feasible and useful but that they have many characteristics in common. And while there are probably important points of difference between the two methods which experience has not yet revealed, these are not vital at present, since the essential welding problem of today is not so much concerned with a choice of welding method as it is with a sane answer to the question of the economic superiority of welding over other methods of steel connection.

Pipe and Pipe Lines

ENGINEERING practice in respect to large water pipe is by no means in full agreement, as shown by the symposium of views which appears on another page. The essential problem is provision of due strength in pipe lines larger in diameter than 20 to 36 inches, through all the vicissitudes of loading, settlement and leakage under continued service, but there is a group of auxiliary factors residing in joint construction, in susceptibility to corrosion and tuberculation, and in local hazards. As the instance of the discharge conduit of the Table Rock Cove dam brings out with sensational clearness, it is often necessary to consider the pipe line as a structure, for under such conditions as there presented it will hardly do to think of a mere assemblage of pipe lengths as a pipe line. With this in mind, the point may be made that perhaps the engineer has not adequately developed the art of designing and constructing pipe lines. If all that can be argued on this score be admitted, however, the week's symposium nevertheless proves that there is an important field for better pipe-line materials. Research and practical development have a definite opportunity here.

Airports on Building Roofs

NEWS that a building is being planned in Los Angeles whose roof is to accommodate a 200x1,200-ft. airplane landing field calls attention to the numerous theoretical difficulties involved in such a project. At the present stage of aircraft development, comparatively extensive take-off and landing areas are necessary for heavily laden ships. Furthermore, these areas must present their longest dimension to the wind direction of the moment if maximum safety is to be observed in aircraft handling. Vertical currents, gusts and quickly shifting winds are engendered by the building supporting the landing surface and also by neighboring buildings so that landings and take-offs will be rendered difficult. Such roof airports, if they serve their purpose, must be in the central part of a city, and approaching aircraft must pass over congested regions while flying at low and therefore dangerous altitudes. Records of aircraft accidents indicate that the majority of them occur either when landing or when taking off. To mitigate the take-off hazard, airports are providing ample open spaces to either side, giving the pilot a chance to come down safely in case of a forced landing. Obviously a long narrow roof would not meet this requirement. Noise of aircraft is another disadvantage of attempts to use building roofs as airports; the necessity of designing roofs and walls of adjacent buildings strong enough to resist an airplane crashing against them is still another. If it is necessary to cantilever the roof out from the edges of the building to secure adequate width, sunlight will be shut out of the offices below. In addition, there is the matter of cost. Despite all these disadvantages there is no obstacle that absolutely precludes the construction of such a roof airport, and developments in the Los Angeles project therefore will be watched with considerable interest.

Knowledge of Earth Dams

THIS week's account completes the record of the partial failure of the high earth dam at Table Rock Cove, South Carolina, in full and illuminating detail. The repair of the break in the dam was remarkable, even brilliant; not only did it deal with conditions never before encountered but it involved serious engineering questions in spite of the fact that the reservoir was not needed for immediate service. It is now possible to look back on the entire case since the partial break in the dam early in May, 1928. At that time the dam nearly failed, being saved by only a narrow margin—a margin that now seems even narrower in view of the alarmingly extensive breakage of the outlet pipe. The original failure was somewhat confused by the occurrence of an embankment slip separate from the washout over the pipe, but in the light of the present facts this slip may have been caused by waters originating in the fractured pipe. All else aside, however, the pipe failure is the sensational feature of the case. It is the most impressive demonstration ever obtained of the dangers residing in a pipe which pierces an earth dam. The pipe was under reservoir pressure on its full length, since there was no shut-off at its upper end. It was neither bedded upon a firm support nor protected in any way from the earth load of the embankment. As now shown, nearly its full length was destroyed. The breaks in all likelihood are attributable to the pressure of the embankment rather than to disturbance by the washout, since the latter did not result in any breaking back of the embankment or other evidence of movement near the pipe. The record contributes in a notable way to knowledge of earth dams; it should render impossible the future creation of similar outlet conduit hazards.

Daniel A. Garber

A STRONG leader and a wise counselor is lost to organized contracting by the death of Daniel A. Garber, manager of the Associated General Contractors of America. Accepting the office after long and successful work in large construction had enabled him to retire from active business, Mr. Garber brought solely the desire of service to his task. This gave him an independence of thought and a frankness of speech that spurred action and swept aside dilatory tactics. His measure of association usefulness was work accomplished. And as one of the organizers of the association, as its first president and as a director through its ten years of development he knew better than most what that work had to be. He was actively occupied in carrying it out when he died. A strong man is gone, and a strong man is needed to take up the tasks which he had to relinquish.

Rail Terminal Charges at Port

A RATE decision of wide importance in port development has been made by the Interstate Commerce Commission. After an investigation into charges for wharfage, handling, storage and other accessorial services at Atlantic and Gulf ports, extending over several years, the commission states that it can find no warrant for prescribing that these charges be stated separately from line-haul rates on export, import or other traffic passing through those ports, as requested by some of the ports and by bodies operating state or municipally owned terminals at several of the ports.

Ports where terminal costs are low favor such a proposal because they believe it will show that the railroads are accepting less for their line haul from centers like Chicago to ports where terminal charges are high than they are accepting to the low-cost ports under the present all-inclusive rates, although the distances are substantially the same. Separation of line-haul charges would force a change in line-haul rates which would put these low-cost ports on a par with the other ports as regards the cost of freight delivered at their receiving yards. Shippers would then benefit from the lower terminal cost. Similarly, ports with low terminal charges, even farther removed from the inland centers, would benefit at the expense of the high-cost terminal.

Independent rail-water terminals also would benefit. It is difficult now for them to compete against the railroad-owned port facilities, because their facilities cannot be operated at a loss, whereas the railroad's terminal facilities can, the loss being absorbed through a reduction of the net return from the line haul.

Superficially, this line of reasoning appears sound, but it fails to take into consideration some factors of importance. Chief among them are the quantity of freight handled, the export facilities at each port and the need for simplicity in rate structures. Generally speaking, the more business a port handles the higher its terminal cost. On the other hand, the more business it handles the lower are the line-haul costs to the port, and so there is reason for spreading out part of the terminal charges over the line haul.

Availability of cargo space and frequency of ship sailing are other important factors. Even though terminal charges were made separate from line-haul charges, it is to be expected that many shippers would pay the extra charges at the busier ports for the greater assurance of quickly available cargo space to cut down storage charges and to speed up delivery. Simplification of rate structure also is not to be overlooked. If terminal charges at ports are to be separated from line-haul charges, why not separate all terminal charges, or even go farther and break down line-haul costs to separate those which are high from those which are low for the benefit of shippers in the low-cost territory? To do so would be to step backward. Many such proposals were tried out years ago and abandoned as being too cumbersome. A certain amount of theoretical benefit must be sacrificed for simplicity.

The Interstate Commerce Commission does well to adhere to that principle. Just now we appear to be on the threshold of a period of great change in methods of handling freight at railway terminals of all kinds. The use of motor trucks between outlying freight yards and off-rail terminals within our cities, store-door delivery, and container cars, all are factors which may radically affect future methods of handling freight. At a not distant date the railroads may find it desirable to move their terminals or make other changes to take advantage of these developments. It is inadvisable, therefore, to set up any artificial barrier to the making of such changes.

Highway Progress in Kansas

LONG one of the most backward states in dealing with its roads, Kansas now presents a highway situation of unusual interest. In the first place, it is limited by law to the construction of only 100 miles of hard-surfaced roads per year until the major part of the state system shall be brought to standard grade and cross-section. Such legal limits to the expenditure of highway departments on high-class road types are rarely placed in effect, although they have often been considered in planning state highway programs. Kansas stands today where many other states stood a decade ago—just free of county control of state roads and facing the opportunity and the necessity for developing a highway network useful to the state and nation alike.

The state roads comprise 8,690 miles. The county roads total 132,526 miles, and in Kansas these roads are more important than in many other states, since they provide the routes to market for the state's farm produce. Their importance has been recognized in the new state highway law, which gives the counties nearly 30 per cent of the proceeds of the 3c. state gasoline tax. The more unusual provision of the law, however, is that the entire mileage of state roads shall be drained, graded and surfaced with sand or gravel before more than 100 miles of hard-surfaced highway may be constructed per year. Whether a highway department should be bound by such an inflexible rule is a moot question. Its object is clear and without doubt well founded—namely, to assure that highway funds will not be lavished on a single route, bringing it up to highest perfection while permitting the larger part of the state mileage to remain unimproved. On the other hand, experience has often shown that highway needs cannot be predicted far ahead, and that a ruling logical now may prove a handicap later on. But the important feature of the Kansas plan is that it is a plan, which is more than Kansas has had heretofore.

What has been accomplished? Since the new road law went into effect in April, $6,000,000 of contracts have been let, covering the surfacing with sand or gravel of 800 miles of the estimated 2,095 miles necessary to tie all of the counties into the state system; and an additional 800 miles is authorized awaiting funds from the gas tax. At the end of the year nearly 1,000 miles of new sand-clay road will have been added to the state highway system and 100 miles of new pavement will have been completed. It is hoped that another 1,000 miles of sand-surface can be added during 1930.

Gaged by results in some other states, these mileages are not impressive, but in Kansas they are of immense strategic importance, for they fill gaps in highways that were through-state routes in name only. Thus the state has made a start toward bringing its highways into favorable comparison with other states. Gradually it is lifting itself out of the mud, and as it does so the mental detour signs that have completely lined its boundaries will disappear. Kansas is on the threshold of immense possibilities in highway development, but it should remember what other states have learned—that no road program is ever completed. It is not too soon to map out plans for the next five years.

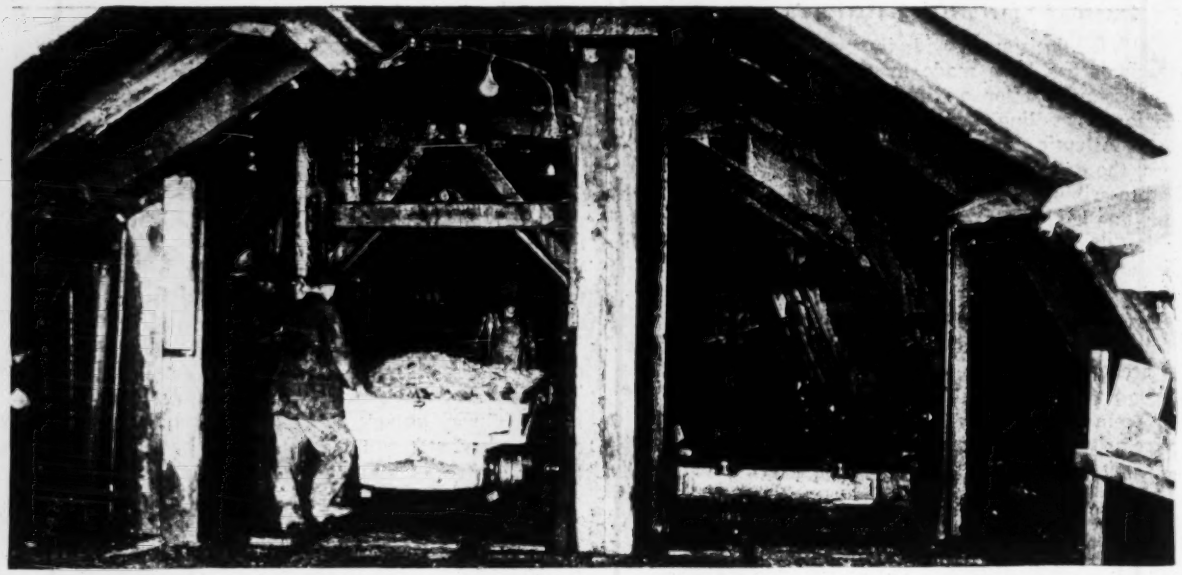


FIG. 1—BOTTOM OF SHAFT OF HAGANS TUNNEL, L. & N. R. R., SHOWING SIZE OF CROWN HEADINGS
20-in. fabric ventilation tube shown at left leading into heading.

Heavy Construction on New Line for L.& N. R.R.

Deep Cuts, High Fills and Four Tunnels on 13½-Mile Branch Being Built Through Cumberland Mountains—Plant and Equipment Dragged Over Hills by Tractors to Working Sites

FOUR tunnels, one more than 6,200 ft. long, and 1,000,000 cu.yd. of grading are features of a new line 13.6 miles long being built through the Cumberland Mountains of southeastern Kentucky by the Louisville & Nashville Railroad to provide an additional outlet from the Harlan coal fields. The new branch runs from Chevrolet, Ky., south to Hagans, Va., with a ruling grade of 0.5 per cent southbound, and no adverse grades northbound. To maintain this low grade in a rough country required the long tunnels and heavy grading. The line follows Martin's Fork valley most of the way, crossing the stream at six points. As much of the region traversed by the line is wild, mountainous country, almost inaccessible, much of the heavy equipment was dragged over the hills by 60-ton tractors, with steam shovels on crawlers traveling under their own power. Construction of the line was started in November, 1928, and completion is scheduled for June, 1930.

The new line will provide a short cut to the south and east from the Harlan coal fields, connecting with the present Cumberland Valley division of the L. & N. at Hagans. As the present outlet from Harlan is over a 39-mile double-track line to Pineville, Ky., 40 miles west of Hagans on the Cumberland Valley line, the new branch will replace approximately 79 miles of mountain road for south- and east-bound traffic. From Hagans this traffic will move over the L. & N. to Norton, Va., thence over the Interstate Railroad to the Clinchfield Railway at Miller Yard, Va. The L. & N. and Atlantic Coast Line recently leased the Clinchfield.

Piercing the main range of the Cumberland Mountains, the Hagans tunnel, 6,215 ft. long, has its south portal in Virginia and its north portal in Kentucky, and forms the southern end of the new line. The present Cumberland Valley line crosses the tunnel line at right angles, 102 ft. above and 200 ft. north of the south portal. To provide natural ventilation through this bore the vertical clearance will be 24 ft. above top of rail to the lining, 2 ft. more than standard, with the side walls clearing 16 ft. inside of lining. The tunnel will be lined throughout. With the concrete lining 2 ft. thick in the arch and sidewalls, and all timbering 12x12 in., the excavation for Hagans is 31½ ft. high and 21 ft. wide. The remaining three tunnels are standard size for single-track bores. The tunnel at Redwine Gap, 1,100 ft. long, will be lined throughout, but the Smiley tunnel, 350 ft. long, and the Cawood tunnel, 1,280 ft. long, will be concreted only at the portals and along the invert. The location of the new line and tunnels is shown in Fig. 3.

A cross-section of the Cawood tunnel is shown in Fig. 5. This is typical of all four tunnels except for vertical clearance, the Hagans tunnel being 2 ft. higher. All four tunnels are on tangents, except the Cawood.

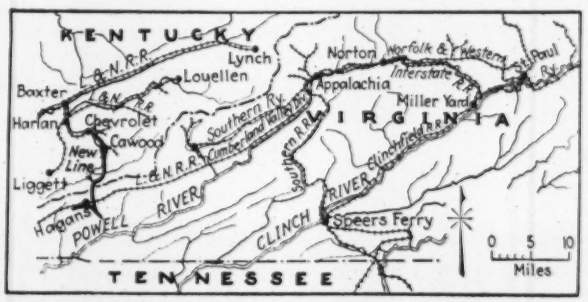


FIG. 2—MAP OF DISTRICT, SHOWING CONNECTIONS AND OUTLETS FOR NEW LINE

which is spiraled at the north end on 28-ft. chords. In all the tunnels a heading comprising the arch section above the spring line was driven and holed through before the bench was started.

Hagans Tunnel—Considerable trouble was experienced

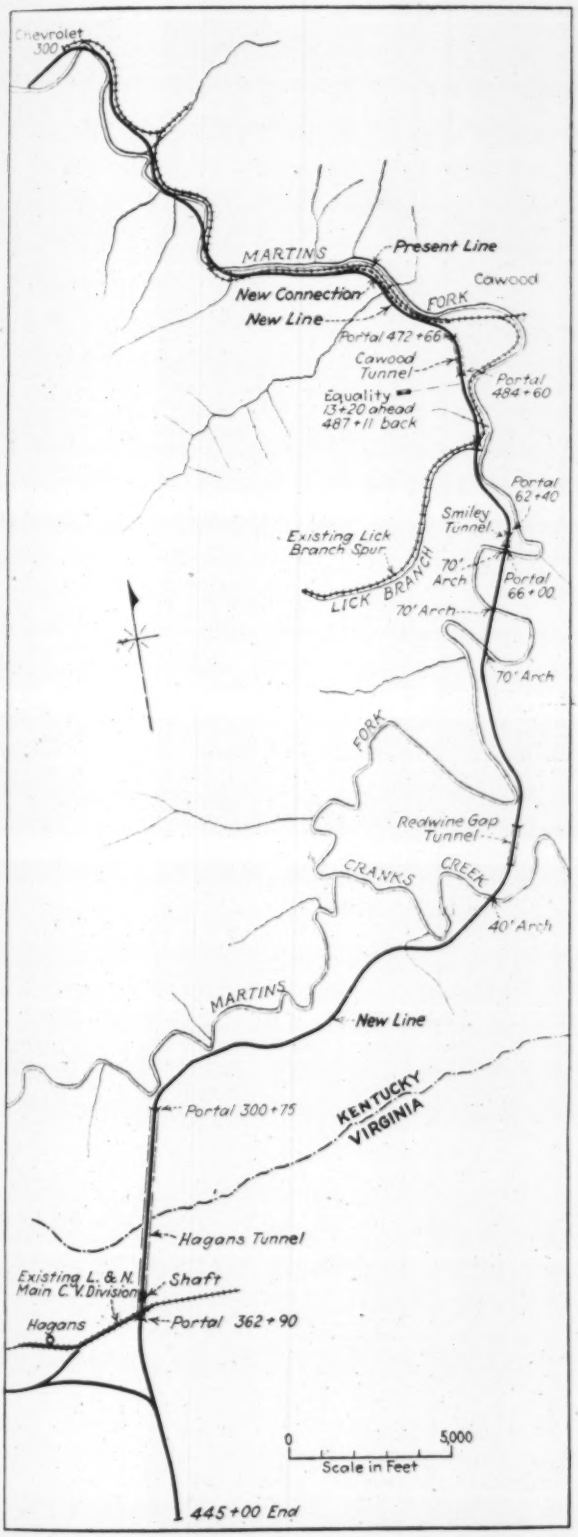


FIG. 3—MAP OF NEW LINE UNDER CONSTRUCTION BY L. & N. R. R., SHOWING LOCATION OF FOUR TUNNELS

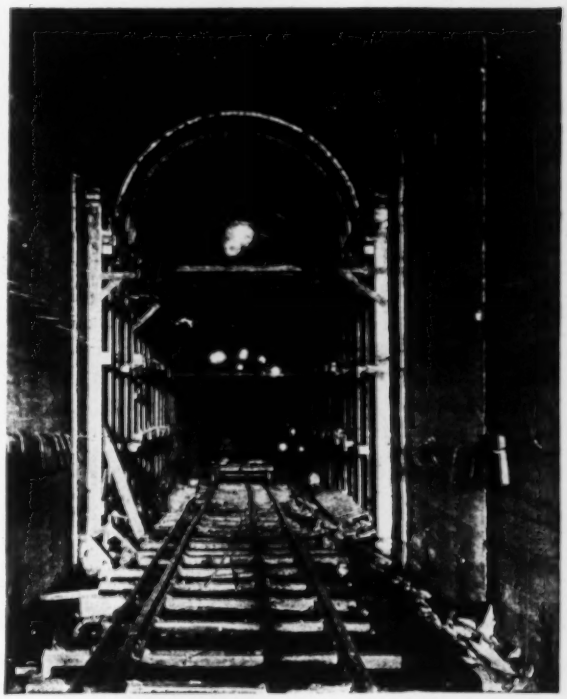


FIG. 4—LINED SECTION AT SOUTH END OF HAGANS TUNNEL

in driving the Hagans tunnel at the south portal because of extremely soft ground conditions. Work was started from both portals, but at the Virginia portal progress was so slow, because of settlement of the overlying slope which endangered the existing main-line tracks, that a 12x21-ft. shaft, 150 ft. deep, was sunk on the tunnel line 700 ft. from the portal. From this shaft crown headings were started both ways (Fig. 1). Work advanced slowly at the same time from the portal toward the shaft.

Soft ground encountered between the shaft and portal required drifting for wall plates in 3x5-ft. tunnels. To provide for settlement the wall plates, 12x12-in. timbers 16 ft. long, were placed 3 to 5 in. high. But little blasting was required in this section. Arch timbering of five segments of 12x12-in. timbers and 3-in. lagging followed close to the excavation. After the heading was holed through, the bench was started from the portal, working back toward the shaft, excavating being done with a steam shovel. Plumb posts, 12x12, were placed on 4-ft. centers, some being forced out of line by side pressures. As an emergency measure the section between the portal and shaft was concrete lined, the lining done by hand, following close to the excavation.

Working the crown heading north from the shaft much better material was found, the rock strata being inclined at 45 deg. and cutting the tunnel line at 89 deg. Timbering was required only through the soft ground at the south end and through occasional strata of shale. The shale, though structurally sound, disintegrated rapidly when exposed to the air, so timbering was used to protect the workmen.

Drifter drills mounted on columns were used in both north and south crown headings. The headings advanced about 7 ft. per round. All muck was handled by machines (Fig. 6) loaded on narrow-gage cars. On the Virginia end mules hauled the cars to the shaft, while

on the Kentucky end gasoline dinkeys were used in hauling the muck cars. The shaft contained two hoisting skips and the cars were handled at the surface to the dump by an air hoist and cable. This method successfully handled the cars on the dump up to 2,600-ft. haul.

Ventilation was supplied by blowers at the shaft and north portal through 20-in. fabric tubes which were carried close to the headings. The tubes, being light, were easily handled and could be quickly removed and replaced for blasting operations.

The benches are being driven by using two lifts of almost equal height, the top lift stepped back about 13 ft. For the most part the drilling is done vertically with jackhammer drills. Drilling practice varies with the rock, but usually three rows of seven holes each are drilled in each lift. The row of holes nearest the face is fired instantaneously, except for the two corners, which are fired on a first delay along with the second row, both

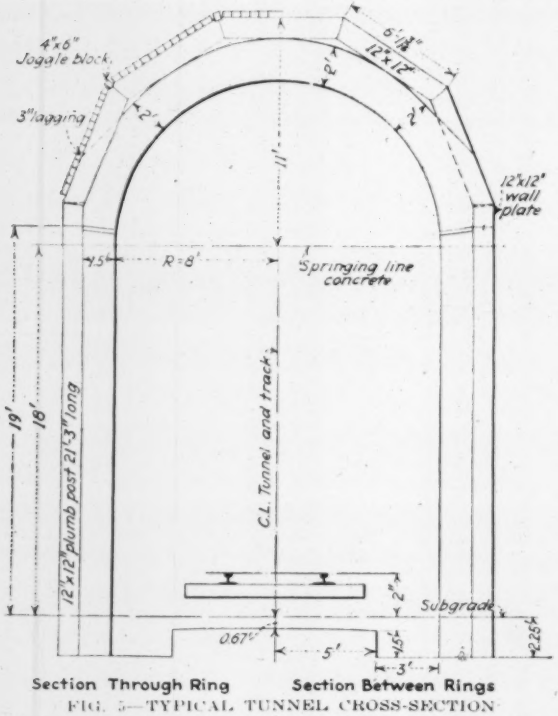


FIG. 5—TYPICAL TUNNEL CROSS-SECTION

Three of the tunnels are this size. Hagans tunnel having a clearance height of 26 ft. above base of rail for ventilation purposes.

lifts being fired at the same time. Likewise the corner holes of the second row fire on a second delay with the third row, with the corner holes on this row fired by a third delay. Occasionally horizontal drilling is resorted to in the benches, but as this requires scaffolding, it is not used except where necessary on account of rock conditions.

Mucking out the benches is done with ¾-cu.yd. air shovels loading into 4-yd. narrow-gage cars. Gasoline dinkeys haul the cars to the portals, at the north end direct to the dump, but at the south end up a ramp, where the muck is dumped into standard-gage 12-yd. cars for a long haul to the dump. This ramp is shown in Fig. 7.

Concrete Lining—As yet the only lining placed is that between the south portal and shaft (Fig. 4). Concrete materials are brought in from Louisville, Ky., 244 miles away, and dumped from the main line above the portal. A 1-cu.yd. mixer plant is located on top of the

FIG. 6—DRILLING AND MUCKING OUT CROWN HEADING

approach cut at the portal, charged from dump cars running on an overhead trestle. The cars are loaded from stockpiles by a stiff-leg derrick using a clamshell bucket.

Concrete was placed by hand from a standard flat car carrying a scaffold and platforms at two levels. A hopper bucket hanging from a carriage and operating on a 45 deg. incline carried the concrete from the mixer to the platform cars, as shown in Fig. 8. This hopper was operated by an air hoist. For this short section of concreting a standard locomotive handled the scaffold car. Forms were completely rebuilt for every pour. A pneumatic concrete-placing machine will be used in completing the lining.

Tunnel Plant—The power plant at the Virginia end consists of two compressors of 1,000 cu.ft. per minute capacity, direct connected to three-cylinder full-diesel engines. A three-cylinder semi-diesel engine direct connected to a 2,300-volt, 100-kw., alternating-current

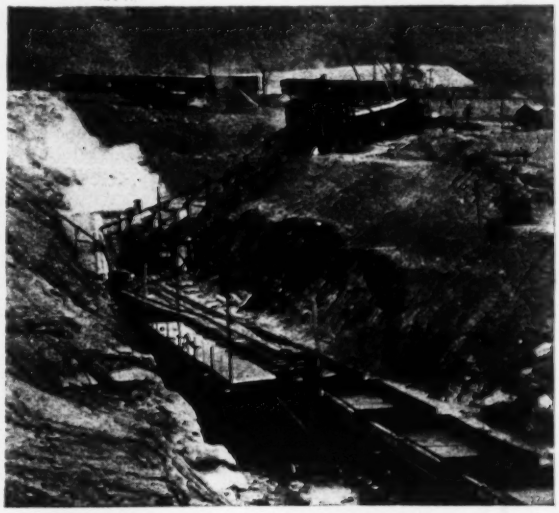


FIG. 7—SOUTH PORTAL HAGANS TUNNEL, SHOWING CONCRETE PLANT AND RAMP FOR TRANSFERRING MUCK TO STANDARD-GAGE CARS

Standard hopper cars at top of picture are on existing main line tracks, showing relation of this line to tunnel. Early slides at portal endangered main line, giving considerable trouble and necessitating sinking of shaft 700 ft. from portal beyond main line.

generator supplies current for lighting the entire tunnel work and camps and for running the fan motors. Oil furnaces and steel sharpeners are located at each portal. At the Kentucky portal but one diesel-driven compressor is used, supplemented by two gasoline-driven portable compressors. These diesel power plants have given very satisfactory service, operating to date more than fourteen months day and night without trouble.

Redwine Gap, Smiley and Cawood Tunnels—These tunnels were driven by practically the same methods as are being used in driving the Hagans tunnel, holing through the crown heading and then working the benches in two lifts. Rock at Redwine Gap was stratified almost parallel to the invert grade, with a 30-in. seam of coal sandwiched between shale and slate strata above and a 6-ft. layer of hard sandstone below, requiring heavy

FIG. 9—EXCAVATING ONE OF HEAVY CUTS
Note well drill used in drilling blast holes and mats at side of cut used under steam shovels at all times except on rock bottoms.

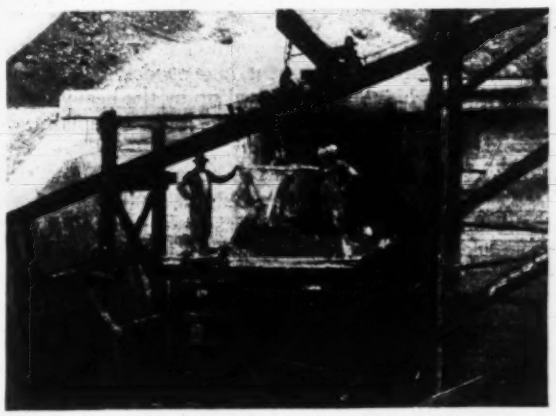


FIG. 8—HOPPER BUCKET FOR TRANSPORTING CONCRETE FROM MIXER TO PLATFORM CAR FOR TUNNEL LINING, HAGANS TUNNEL

timbering. A steam power plant was used on this tunnel, coal being obtained close to the north portal.

The Smiley and Cawood tunnels lie in hard, gray sandstone, requiring no timbering or lining. Steam shovel and steam dinkeys, all burning coke, handled the muck on the benches. Ventilation for the Cawood tunnel benching was provided by a 60-in. mine fan placed in the north portal heading after holing through. The bench was worked from the south end only, as was also the heading.

Grading and Concrete Structures—Much of the million yards of grading on the line is in rock. Steam shovels, cars and steam dinkeys are used on all of the grading work. One of the subcontractors on grading work uses mats under his crawler steam shovels except in rock-bottom cuts, claiming a considerable saving of time in maneuvering the shovels around the work. All of the fills are being built by dumping from trestles built of native timber. The steam shovels were brought into the work across the mountains under their own power. All of the track material, cars and other equipment were brought in on sleds and heavy trailer wagons dragged by tractors, some of it being hauled 5 to 7 miles. This method is also used for hauling fuel and supplies, supplemented by mules and wagons wherever possible. Well drills are used in drilling holes for blasting out the cuts, using gas engines, as shown in Fig. 9.

All grading and bridge work from the Cawood tunnel to the north end of the line, 3.61 miles, was done by railroad company forces, using heavy railroad type steam shovels operating on track for the excavation work. Much of this end of the line parallels the existing Cawood branch line, but new construction was required to obtain the low grade desired for the entire new line.

Concrete Structures—All waterways and existing mine spurs are crossed on permanent structures, some all concrete, others with steel girder spans. Fortunately most of the concrete bridges required are located near the north end of the line, accessible from existing spurs. To build three 70-ft. arches for the Martins Fork crossings a 3-mile temporary standard-gage railroad was built up the river from the Lick Branch spur line. The connection between the new line and the main line at Hagans required several concrete bridges over waterways, which were poured from the concrete plant at the south portal of the Hagans tunnel by using a hopper mounted on a standard flat car.

Contractors and Personnel—The new line construction is under the direction of W. H. Courtenay, chief engineer of the Louisville & Nashville Railroad. George W. Feagan, locating engineer, was in charge of the difficult work of locating the low-grade line through the mountains. G. R. Smiley, chief engineer of construction, has direct supervision of construction work. Resident engineers are H. E. Kloss, C. A. Smith and J. B. Cochran, who is also in charge of the railroad company's forces. W. W. Boxley & Company, Roanoke, Va., are general contractors on the contract section, 10.18 miles long, with the following subsidiary companies engaged on the work: from Cawood to the north end of Hagans tunnel, J. V. Boxley & Company, Smith Leach & Company, W. W. Boxley, Son & Company; on the Hagans tunnel and connections at the south end of the line, Boxley, Bray & Company, all of Roanoke. Dempster Construction Company, Knoxville, is subcontractor on part of the line north of the Hagans tunnel. F. W. Graham & Company, Pineville, Ky., are subcontractors on masonry for the railroad company's section. All track work is being done by the railroad company.

Storm Protection for Lakefront Building at Chicago

Concrete Wall With Wave-Deflecting Parapet Placed to Protect Apartments From Storm and High Water

AN EXAMPLE of the recent extensive storm damage along the lake shore at Chicago is afforded by the conditions at the Aquitania Building, a fifteen-story apartment structure on Argyle St., built on land reclaimed by a sand fill retained on the east and north sides by a timber bulkhead, that on the east or lake side being capped with concrete. The driveway approach from the street is on the lakefront of the building, directly behind the bulkhead, a narrow sand beach extending originally between the bulkhead and the water line. In the future, Lincoln Park and the lakeshore drive will be extended by filling in front of the building to a new shore line, but at present the reclaimed site is outside the old shore line, as will be seen by the accompanying illustrations. Fig. 1 shows the building after the storm, with an excavator standing at the end of Argyle St. Fig. 2 shows the shore erosion south of that street. Fig. 3 is a general plan of the location, showing the new protective work.

FIG. 1—CHICAGO APARTMENT BUILDING ON SHORE LINE

Previous to the rise in lake level and the recent storms there was a strip of sand beach on the east and south sides, while north of the building the water line was only a little back from the face of the building. There is now 4 ft. of water on the east or lake side, while on the north the water line is nearly at the rear of the building. As the structure is founded on concrete piles extending well into the underlying clay, its stability was not affected, but the front driveway was flooded and covered with débris, the main entrance had to be barricaded with sandbags, the service approach or driveway on the north side was washed out, there was water in the basement, and windows on the lake side were broken by water dashed up by the heavy waves, all causing damage to property and much complaint and excitement on the part of tenants.

FIG. 2—SHORE EROSION AT CHICAGO

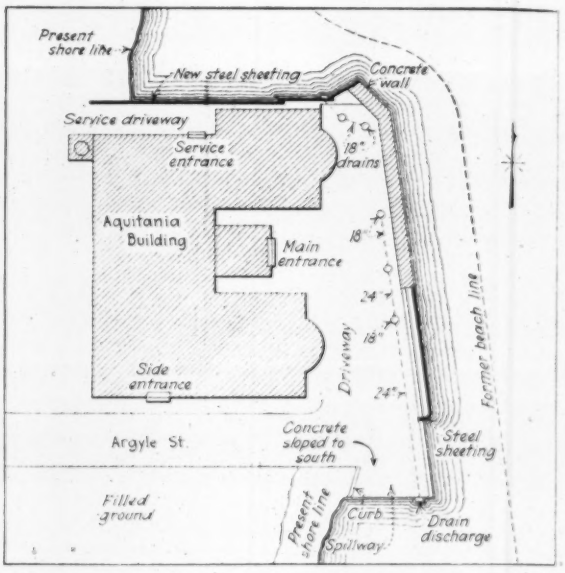


FIG. 3—PLAN OF BUILDING AND PROTECTIVE WORK

For protection against future storms, with the sand beach now washed away, a concrete bulkhead of the wave-deflecting type (Fig. 4) has been built along part of the lakefront property line, where the damage to the old bulkhead was most severe. It incloses this old structure, which consists of round wood piles and sheeting capped by a low concrete wall. A line of 20-ft. interlocking steel sheetpiling was driven through the sand into clay, the top being about 18 in. above the water level and reinforced by a waling piece consisting of an 8-in. channel bolted to the piles. The top of the old curb wall was partly broken away to form a rough surface for bonding

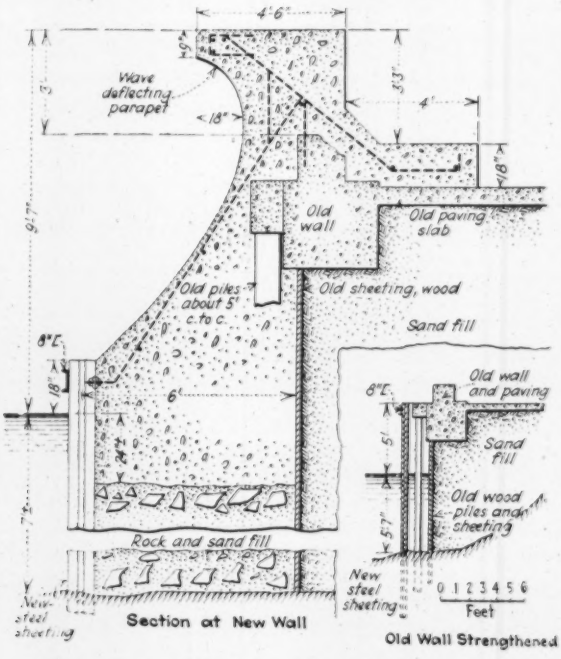


FIG. 4—WAVE-DEFLECTING BULKHEAD WALL

with the new concrete, as shown by Fig. 5. At the north corner this new wall was turned back toward the shore for about 25 ft.

In construction, a 6-ft. trench between the new and old sheeting was excavated down to the clay and the bottom was filled with sand and coarse broken stone to about 2 ft. below water level. The sand was flooded and tamped or puddled to insure a dense mass. On this foundation the concrete wall was built, its reinforcement being anchored to the steel sheeting. At the face, the sloping surface curves outward so as to throw back the waves and prevent solid water from coming over into the driveway. Its top is 9½ ft. above the normal water level, or 3 ft. higher than the old curb wall, and is extended back over the original concrete paving.

FIG. 5—CONSTRUCTION OF NEW BULKHEAD
Note top of old wall broken to insure good bond with new work.

To prevent flooding of the driveway during storms, a row of vertical drain wells was put down in the fill behind the bulkhead (see Fig. 3), those at the north connecting to a drain discharging through the bulkhead on this side and the others to a similar drain discharging at a sloping concrete apron or spillway on the south side of Argyle St. For the remainder of the lakefrontage of the property, where the damage was less serious, the old wooden bulkhead with concrete cap was protected by a row of 20-ft. interlocking steel sheetpiles anchored back into the fill and having an 8-in. channel as a wale along the front, as also shown in Fig. 4.

On the north side the old wooden bulkhead (without concrete cap) had been partly destroyed, and the filling behind it was washed out, together with the rear or service driveway, while the water had encroached so far inland as to cut behind the end of the bulkhead. Here the same type of steel sheeting was driven, extending back beyond the new water line. Its top is 5 ft. above the water, or 4 ft. higher than the old wood piling. No concrete capping was placed. Behind this new protection is a filling of loose rock and sand, upon which the concrete driveway paving was rebuilt. The conditions on this side after the storm and also after the construction of the new bulkhead are shown in Fig. 6. The beach or shore line originally was only a short distance in from the front of the building, but is now almost in line with the rear.

This protection work for the Aquitania Building was designed and built by the Congress Construction Company, with P. Whitham as superintendent in charge. It was built under the direction of C. G. Harden, engineer for S. W. Straus & Company, which firm financed the building.

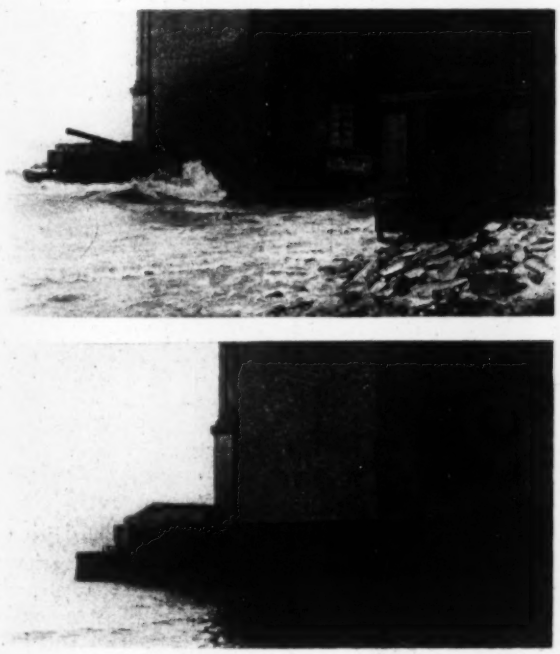


FIG. 6—PROTECTION ON NORTH SIDE OF BUILDING
Above—Condition after the storm; shore line set back and water cutting behind old bulkhead has washed out the service driveway. Below—New sheeting placed and driveway built on fill behind it.

Measurement of Stream Velocity by Use of Air Bubbles

A method of determining the velocity of water flow in a stream or open channel by means of measuring the horizontal travel of an air bubble has been developed by Otorogo Miyagi, of Tohoku Imperial University, Japan. The investigator has determined that bubbles rising through flowing water attain a terminal velocity that is only slightly affected by the bubble size, and that this velocity is in effect after the bubble has traveled an average distance of 3.5 cm. In the method described, the air is introduced below the water surface by a small glass tube nozzle, connected to an air bottle. While rising because of its buoyancy, the bubble is also carried along horizontally by the flowing water, and the point at which the bubble arrives at the surface is determined with the aid of a glass plate with fine scale divisions printed on it, set just in contact with the water surface. The bubble size can be determined by collecting a number of them in a glass tube held beneath the surface and inverted over the nozzle. The total volume occupied by the air, at atmospheric pressure, can be used to compute the radius of a single bubble. When the bubble used is larger than 0.3 cm., the formula presented by Otorogo Miyagi is

$$v = \frac{(7.1r + 17.8)l}{Z_o + 3.5}$$

where v = stream velocity, in centimeters per second; r = bubble radius, in centimeters; l = longitudinal displacement of the bubble, in centimeters; Z_o = depth of submergence of the air nozzle, in centimeters. The error introduced by neglecting the increase in size of the bubble as it rises is very small.

Large Water Pipe

Materials, Joints, Coatings and Cause of Breaks and Other Factors in Design and Construction

Practice and Opinion of Charles W. Burdick, Paul Hansen, D. W. Howes, Dabney H. Maury, Alexander Potter, Frank E. Winsor and Robert E. Horton

SEVERAL articles on large water pipe, as used both in the United States and Great Britain, published in our issue of Sept. 12, 1929, brought out so much interesting and valuable information as to suggest the desirability of extending the discussion to include other engineers. In the articles that follow seven American engineers draw upon their wealth of experience for the benefit of their fellow engineers, and of pipe users, producers, dealers and contractors.

Reliable Pipe for Main Arteries in Large Cities Needed

By Charles B. Burdick

Alvord, Burdick & Howson, Engineers, Chicago, Ill.

CAST-IRON PIPE has now been used in the distribution systems of city water-works with great success for more than 50 years. This experience, coupled with the use of this pipe in isolated cases over periods longer than two centuries, testifies to its great durability under ordinary circumstances. Nothing better has been found for connecting the street pipes than the lead-and-yarn joint almost universally used from the beginning of city water-works. There have been frequent failures in these joints, but they are small in number compared with the many thousands of such joints in a city distribution system.

Failures of the pipe itself occur occasionally. Usually these failures are not serious except in the larger cities, say over 100,000 in population, where the diameters of the main arteries exceed 24 in. and where a serious break carries heavy consequential damages from flooding. It is to provide against such contingencies that water-works men are looking for a better and more reliable pipe for main arteries in the large cities.

Better Lining for Cast-Iron Pipe Needed

Many attempts have been made to supersede cast-iron pipe for the city distribution systems, but the success of such substitutions has not been convincing except where governed by special considerations. The greatest need at the present time, so far as the distribution network is concerned, is an interior pipe surface that will prevent tuberculation and the consequent reduction in pipe-carrying capacity, especially in the case of certain waters. The customary coal-tar coating, while apparently useful, leaves much to be desired. The comparatively recent use of cement for this purpose will be watched with profit during the next few decades.

For the main distribution arteries, larger than 2 or 3 ft. in diameter, and for the larger supply lines, particularly where they are long or where a break might suspend the service, which may be a serious matter these days, it is very desirable that some material should be used for the pipe shell less likely than cast iron to fail through suddenly opening up a large aperture. Steel pipes with shells sufficiently thick to prevent serious impairment of strength from moderate surface corrosion seems to be warranted in some cases. Within the last few years the increased skill in the manufacture of a reinforced-concrete shell has given great promise for reliability, a comparatively long life and probably a greater permanence in carrying capacity. As to which of these materials should be used for large main arteries and important supply lines, economic conditions may properly dictate.

Comparison of Bids for Different Materials

In making a financial comparison tending to govern the selection of pipe, when comparing pipes known to be capable of reasonably reliable service, it is customary and proper not only to compare the investment but also to consider further allowances to cover repairs, depreciation, leakage and prospective damages from failure. Some attempts have been made to settle the basis of such financial comparisons in advance in the specifications issued. This is a difficult thing to do and it is sometimes treading on dangerous ground to attempt to formulate the basis of comparison in advance of the receipt of bids. The best selection is made only by the proper exercise of judgment, after all the data bearing upon the case are at hand. The engineer charged with a decision in this matter will do well to remember that the price bid by an experienced and reliable contractor is the most definite factor in the problem. The other factors are variables at best, depending upon conditions that can be determined only approximately, based upon a more or less indefinite average of experience. However, there appears to be sufficient prospect of success for some of the newer arterial pipes to warrant taking chances in making a selection. The passage of each decade will increase the assurance of success and the experiment of today may become the standard of tomorrow.

* * *

Steel Chosen for 54-In. Water Intake at East Chicago

By Paul Hansen

Of Pearse, Greeley & Hansen, Hydraulic and Sanitary Engineers, Chicago, Ill.

IN CONNECTION with a new water intake that we are designing for East Chicago, Ind., we reviewed carefully the relative merits of reinforced concrete, cast iron and steel. We came to the rather definite conclusion that under the local conditions steel represented the best and most economical material.

We believe that ½-in. thickness of metal for 54-in. pipe is the minimum thickness permissible. We are taking alternative bids on ½- and ⅝-in. thickness.

We are also taking alternate bids on steel and Armco iron. We gave consideration to copper alloys, but decided that they were too expensive and had no great merit for under-water work.

We are taking alternate bids on four types of flexible joint: Victaulic, Thatcher, a design of our own, and a design to be submitted by the contractor if he so desires.

We are laying great stress on the coating of the pipe and handling of the pipe until put in place.

* * *

One Firm's Practice as to Choice of Materials for Pipe Over 30-In. Diameter

By D. W. Howes,
Of Fuller & McClintock, Consulting Engineers, New York City

FOR mains 30 in. or less in size we seldom use anything but cast iron, as other materials are scarcely competitive as to cost and durability. For sizes 30 to 42 in. we usually take competitive bids on cast-iron, steel and concrete pipe so far as local costs and circumstances make these three types suitable. In this range of sizes, cast iron may be eliminated where conditions render it particularly liable to breakage or where the consequences of breakage would be exceptionally serious, as mentioned below. For sizes larger than 42 in. we generally restrict the choice to concrete and steel, eliminating cast iron on account of the increased danger of breakage in the larger sizes.

In cases where the subsoil is very soft, steel pipe may be the only material suitable, on account of its superior strength, ductility and reliability. In other cases unusually corrosive soil or water conditions may mitigate strongly against steel. From the standpoint of convenience in making numerous branch connections, particularly after the line is laid, cast iron is the most and concrete the least suitable.

Judge Each Case on Its Merits

In view of these various and conflicting factors, it is difficult to generalize. We prefer to judge each case on its merits, including the evaluation of the durability and carrying capacity of the materials considered. To illustrate the influence of conditions: A bad break in a large main on Fifth Ave., New York City, might flood valuable stocks in basements of adjoining stores and do hundreds of thousands of dollars damage, and the heavy traffic and frequency of street excavations here endanger a pipe line made of brittle material. In less congested streets of private homes, the likelihood of breakage and the seriousness of it are both greatly decreased.

Summary of Practice in Firm's Recent Steel-Pipe Installations

Practice as to details of cast-iron mains is conventionalized and requires no comment. The making of concrete pipe is highly specialized, and aside from requiring that the manufacturer shall have had ample experience and that he shall lay the pipe, we usually follow his standard practice as to details. Steel-pipe practice involves the exercise by the engineer of more judgment as to design features. The following is a brief summary of our practice in recent large steel-pipe installations:

Alternate Types—Several types of riveted, hammer-welded and lock-bar pipe were specified as alternate, subject to slight differential in diameter to offset variations in carrying capacity.

Quality of Metal—Firebox steel, flange quality, serial designation A30-24 of the American Society for Testing Materials, was specified on the basis that the greater ductility of this steel is of sufficient advantage, particularly in making up field joints, to more than compensate for its extra cost.

Thickness of Plate—Our practice is to figure thickness of plate required, using the desired factor of safety, and add $\frac{1}{16}$ in. for corrosion. However, we hold to the following: for pipe less than 48 in. in diameter a minimum of $\frac{3}{8}$ in.; 48 to 72 in., $\frac{7}{16}$ in.; and for larger sizes, $\frac{1}{2}$ in. or more.

Cleaning of Plate—Pickling the plate to be used for the pipe gives a very clean and smooth surface and removes all mill scale. However, when using this method, all trace of acid and alkali must be removed. This makes the process delicate and its success depends largely on the care and experience of the persons doing the work. In the absence of assurance beforehand as to these qualifications, we do not favor pickling as a general rule, but rely upon mechanical cleaning. This is accomplished by use of wire brushes and careful inspection. Sand blasting gives a very clean plate, but is extremely expensive and slow and the result not worth the additional expense.

Coating—Our practice is in favor of dipping pipe to apply coating, as it seems to be the only practical method of obtaining a uniformly smooth surface. For the material used we favor an asphalt base.

Wrapping—On a recent undertaking—namely, the Wanaque aqueduct, which will supply the cities of Newark, Paterson, Passaic, Clifton and Kearny and several smaller towns in northern New Jersey—we have specified the use of an additional outside protection over and above the usual coating. This comprises outside special wrapping of impregnated felt, applied at the shop after the pipe has been given its usual dip coating, following the procedure used in a number of the Pacific Coast installations. As the felt is wrapped around the pipe under tension additional dipping material is applied to cement it to the pipe. The field joints are wrapped in a similar manner except that a cold asphalt compound is used, as it is much more practicable under field conditions. It has been our experience that the comparatively small extra cost of this wrapping is more than justified by the great reduction in the number of abrasions of the coating caused by transportation and handling, besides which its use incidentally results in approximately doubling the amount of coating material applied to the outside of the pipe and presumably thus increasing its life.

* * *

Earlier Conclusions on Value of *C* for Various Materials After Use Confirmed

By Dabney H. Maury
Consulting Engineer, Chevy Chase, Md.

THE writer agrees entirely with the opinion of Caleb Mills Saville to the effect that no satisfactory bituminous or asphaltic dip yet brought out will protect the internal surface of cast-iron, steel or wrought-iron pipes against tube.culation; nor has he much faith in the efficacy of such materials as a protection against pitting

of the outer surfaces of such pipes when laid in salt marshes or exposed to electrolysis, even when the hot material is applied in connection with a wrapping of felt or burlap. The speedy failure of the steel pipe supplying Atlantic City is one instance of the action of a salt marsh on such a coating; and the writer found the coated and wrapped steel mains in Butte, Mont., seriously damaged by electrolysis.

Mr. Saville's paper is an excellent example of the way in which all of the conditions of each particular installation should be studied and allowed for in the letting of contracts.

The writer does not concur in the opinion of E. A. Sandford-Fawcett in regard to reinforced concrete, referred to in "Observations From an Editor's Note Book," appearing in your issue of Sept. 12.

Never Knew of Sound Cast-Iron Pipe Ruptured by Internal Pressure

The writer's experience coincides exactly with that of William W. Brush as to the nature of and damage caused by breaks in cast-iron mains laid in city streets. Except where such mains had been very seriously damaged by electrolysis, the writer has never seen an instance of rupture caused by internal pressure in a sound cast-iron main. Breaks are usually caused by settlement, and in most cases the bell of the pipe is split, as stated by Mr. Brush. The writer believes that breaks are often caused by settlement due to joint leaks, and that this is likely to be the case when the bells are split, although the construction of near-by sewers, subways or the like is undoubtedly a prolific cause of settlement. The writer has, however, observed a number of breaks in which a large piece of a cast-iron main had been broken out of the middle of the pipe, either from the top or from the bottom, without any cracking of the bell. Such breaks may have been caused by settlement or by unequal support of the pipe throughout its length.

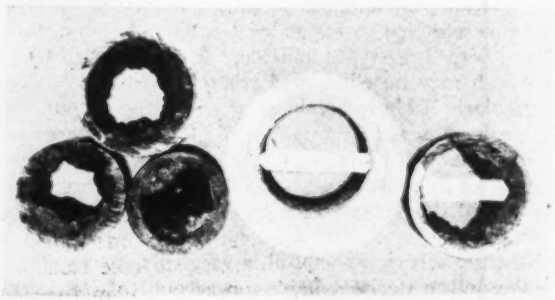
Relative Values of C in Cast-Iron, Reinforced-Concrete and Wood-Stave Pipe

On May 21, 1924, the writer presented before the New York convention of the American Water Works Association a paper entitled "Large Supply Mains." (*Jour.* A.W.W.A., September, 1924; abstracted at length in *Engineering News-Record*, June 19, 1924, p. 1052.) After a brief history of the development of cast-iron, steel, reinforced-concrete and wood-stave pipes and a description of the advantages and disadvantages of each type and of the precautions to be taken in the installation of each of them, estimates of the first cost of each type of each size, and for different pressures, under certain assumed conditions, were presented. Following this, the physical characteristics of each type were discussed with regard to their respective carrying capacities, leakages and durabilities, and a financial comparison of a typical installation was given, showing in dollars and cents the allowance which should be made for each of these characteristics. For the purpose of this financial comparison, the paper referred to assumed a value of the coefficient C in the Hazen-Williams formula of 100 for cast-iron and steel pipe in service for twenty years, of 130 for reinforced-concrete pipe and of 115 for wood-stave pipe. The writer's experience since that time would appear to justify a value for C of at least 140 for reinforced-concrete pipe well spaded against smooth steel forms, and of 130 for well-built redwood-stave pipe.

The 19-mile pipe line for Norfolk, Va., was composed in part of bell-and-spigot cast-iron pipe, in part of flexible-joint submarine cast-iron pipe, in part of reinforced-concrete pipe and in part of wood-stave pipe. Tests made about four years after this pipe line was laid showed that the value of C in the bell-and-spigot cast-iron pipe had decreased from between 130 and 140 when the pipe was new, to 110; while the value of C was 140 for both the reinforced-concrete and wood-stave pipe. No estimate could be given of the value of C in the flexible joint pipe because of its many deflections.

F. C. Scobey, in his tests of the 60-in. lock-joint reinforced-concrete pipe laid for the water supply of Tulsa, Okla., found values for C of from 150 to 152.

The writer's experience would confirm the values of C, as an average, for different ages and sizes of cast-iron and steel pipe as given in the Hazen-Williams hydraulic tables. These values will, however, vary greatly with the character of the water carried by the pipes. As a rule, the values of C for twenty-year-old pipes carrying the waters of the Atlantic seaboard will be found to be



CAST-IRON AND CEMENT-LINED STEEL PIPE AT NORFOLK, VA.
Fig. 19 of D. H. Maury's paper, mentioned in his discussion just below.

smaller than those given in the tables; while the values of C for twenty-year-old pipe carrying the hard waters of the Middle West will be larger than those in the table. For example, in the cast-iron supply mains for Norfolk, Portsmouth and Newport News the value of C decreased from 130 or 140 when the pipes were new, to 70 in from 17 to 25 years. One of these lines, which showed a value of 70 after 17 years, was then cleaned, with the result that the value of C increased to 110; but seven years later C for this pipe line had gone back to 70 again. On the other hand, pipes in Illinois, which carry hard well water containing practically no iron or sulphur, showed very little tuberculation after twenty years service.

Reinforced-Concrete Pipe

It may be in order here to quote from pages 35 and 36 of the writer's paper of May 21, 1924, already referred to:

> Concrete pipe has not been in use nearly so long as either cast-iron or steel pipe, but concrete is generally recognized as a very durable material, and the steel which gives the pipe its strength is embedded in and protected by the concrete. Fig. 19 shows samples of cast-iron and of cement-lined steel pipe, all of which were cut from water mains in the city of Norfolk and all of which had been laid in similar soils and under similar conditions for more than twenty years prior to the time when they were removed from the ground. The outside of the cast-iron pipe showed little or no corrosion. Its interior surface, however, had been very seriously corroded by the organic acids in the swamp water conveyed by the pipes. In places this corrosion extended half way from the inner to the outer surface of the pipe, and the metal dissolved by these acids was redeposited in the tubercles shown in the picture.
>
> The concrete pipe shown consisted of an inner lining of ½ in.

of cement mortar, a thin riveted diaphragm of No. 20 gage steel, then a thickness of ¾ in. of cement mortar, and finally an outer shell of No. 28 gage steel.

The outer steel shell showed some corrosion, but the twenty-gage steel diaphragm between the two layers of cement mortar was absolutely as good as the day the pipe was built, and showed no corrosion of any kind, notwithstanding the fact that when the cement was broken away from it there were drops of moisture on the surface of the thin steel plate.

The theory advanced for the surprisingly good condition of this steel diaphragm was that the presence of the protecting layer of concrete prevented any interchange of the water which first seeped through the mortar to the steel and consequently any renewal of the dissolving reagents contained in it, and that the acidity of this water was probably neutralized in the first instance by passing through the concrete.

A few decades ago cement-lined iron pipe was used quite often, especially in New England, and almost every engineer who has examined this pipe after it had been in the ground for some years has remarked on the excellent state of preservation of the wrought-iron or steel diaphragm embedded in the concrete.

There has recently come on the market a new kind of pipe for water mains which, in the writer's opinion, merits careful consideration. This pipe was invented in France and installed in large supply mains for Paris and in other places abroad. The Asphalto-Concrete Corporation, of New York City, is the American licensee of the French patents and has a manufacturing plant at Hicksville, Long Island. None of this pipe is yet in actual service in this country, although a test line of 100 ft. of 36-in. pipe is on exhibition at the Hicksville plant. In the manufacture of this pipe a shell of concrete reinforced with steel is first made by the centrifugal process, and before the concrete in this shell has set, carefully graded stones or fragments of coke or of a hard-burned clay are partly embedded in the shell by centrifugal action. The purpose of these stones or fragments, which are from ⅛ to ½ in. in diameter, is to afford a rough surface for a lining of asphalt ½ in. in thickness, which is afterward added by centrifugal action. It is claimed that this pipe thus lined with asphalt has a high value for the coefficient *C*.

The Lock Joint Pipe Company, of Ampere, N. J., has for years been constructing large supply mains in many places throughout the country, and the excellent results obtained from these installations requires no further discussion here.

* * *

Observations on Cast-Iron, Steel and Reinforced-Concrete Pipe

By Alexander Potter
Consulting Engineer, New York City

IN SELECTING materials for large water-supply mains consideration should be given to location, durability and cost. Location can be divided into three classes: (1) isolated country, where the cost of haulage and handling is a prime factor; (2) rural, where laying conditions are ideal for all classes of materials; (3) cities, where electrolysis with damage to other structures caused by pipe breaks would be serious and expensive.

Durability or life of cast-iron and steel pipe under the various conditions is fairly well agreed upon, but of reinforced-concrete pipe comparatively little is known except what can be deduced from the durability of other reinforced-concrete structures. In the manufacture of cast-iron and steel pipe chemical analysis determines the relative strength of the materials, after which it is run through a certain fixed process, while in the manufacture of reinforced-concrete pipe we have many factors to contend with—namely, quality of the materials, weather and differences of opinion as to the best methods of mixing and placing the concrete. It has been the experience of the writer that the majority of pipe manufacturers think they can produce by their own method better and stronger concrete than if they follow specifications written by an engineer. If they follow specifications and a failure occurs the engineer may have to assume the responsibility, as he has specified the materials and method of procedure. To avoid disputes of this nature in the manufacture of reinforced-concrete pipe the engineer should specify the length of curing, pressure and leakage test and the form of joints and should not go into the mixing methods.

Inside Joints Should Be Carefully Sealed and Pointed Up

The sealing of the joints on the inside of the pipe was brought forcibly to the attention of one of the writer's staff a year or so ago on the inspection of parallel lines of 60- and 48-in. cast-iron water pipe; the former having been laid 19 years and the latter 15 years at the time of inspection. All the inside joints of the 60-in. pipe were pointed with a rich mixture of sand and cement, while those of 48-in. line were not pointed. The interior of the 60-in. pipe showed very little growth, while the growth in the 48-in. line was quite pronounced, extending in both directions from the joints.

It has been urged that repairs to steel and steel-centered concrete pipe can be more readily made than repairs to cast-iron pipe. This may be so in large cities where the maintenance crew is always in readiness and the employees are well versed in the art of welding; but most of the smaller cities do not keep such a man on their crews.

In my experience, more than 90 per cent of breaks are caused by improper grading of the bottom of the trench and by faulty backfilling under and around the pipe. In the latter case I have found that shovels or ordinary tampers do not produce the desired results, but by the use of offset tamps as used on the railroads for tamping ties one can get better and lasting results.

An interesting experience has been had recently by the writer in the construction of more than half a mile of 54-in. cast-iron pipe laid above ground on concrete piers joined with Hydro-Tite for a sewage conduit where there will be for all time a fluctuating flow. The specifications called for a test of 15 lb. internal pressure. At the beginning of the tests considerable leakage developed; this was taken up in 24 days and at the end of this time the leakage was 834 gal. per mile per day. The pipe remained out of service for a part of a year and I had hoped to include in this article some information regarding the leakage after the pipe was again put into service. This information will be forthcoming at a later date.

* * *

Transmission of Water Under Pressure

By Frank E. Winsor
Chief Engineer, Metropolitan District Water Supply Commission, Boston

ALL the improvements in transportation and communication since the dawn of history have occurred within the lifetime of those whom we still remember or who are still with us. A similar statement would apply to the transportation of water, which has been collected and distributed for many centuries, but not until the

advent of cast-iron pipe some 100 years ago was there any practical means of delivering it under any considerable pressure.

Following the introduction of cast-iron pipe it remained, until very recent years, as practically the only material available for the economic distribution of considerable quantities of water under such pressures as usually prevail in systems supplying water for municipal use and for fire protection.

During the past three or four decades steel pipe has in many places been gradually replacing cast-iron pipe of the larger sizes, and during the past decade reinforced-concrete pipe, with or without an interlining of steel, has successfully entered the competitive field.

No ideal material, combining long life, freedom from corrosive and electrolytic ills, ease of tapping for future connections, elasticity sufficient to withstand unequal external loads, etc., is economically available; but it appears not improbable that some material may develop, as time goes on, which will far better meet these exacting requirements than anything now in use. There never has been a time of greater uncertainty as to the future, or of greater promise for better products. So long as cast-iron pipe had no competitor there was little incentive for improvement of product; but with the present rivalry, particularly in the larger sizes, among cast iron, steel, various types of reinforced concrete, and possibly metal alloys, there is reason to hope for new products which will, to a considerable extent at least, combine the best of the qualities present in all the materials now available at a not prohibitive cost. Improvements in protective coatings may overcome many of the objections to the use of materials which, while otherwise satisfactory, are subject to corrosion and tuberculation.

Cast Iron Appears to Lead for Sizes Up to About 20 In.

In the smaller sizes of pipe used in distribution systems, say up to about 20 in. in diameter, cast iron still appears to lead the field with no near competitor in first cost combined with long life; but in larger sizes there is considerable choice and no general rule can be laid down. Decision as to the best materials can be made only from a careful analysis of the variables in each individual case. Competitive bids on various kinds of pipe, with differentials to allow for relative carrying capacity, useful life, etc., may be obtained. The corrosion or other qualities of the water to be carried by the pipe may be an important consideration, and the outside stresses to which the pipe line may be subjected may dictate a choice of materials. While long life is important, it should not be forgotten that many structures become obsolete long before the end of their useful life.

* * *

Always a User of Cast-Iron Pipe—Some Causes of Breaks

By Robert E. Horton
Consulting Engineer, Voorheesville, N. Y.

I HAVE always been a user of standard cast-iron pipe. I believe, however, that there are now available various forms of cast-iron pipe which are, to say the least, promising.

It is my opinion that breaks in large cast-iron pipe are often the direct result of the pipe becoming bell-hung. Indirectly they are the result of inadequate blocking or tamping underneath the pipe so that the upper half of the bell of the pipe has to carry a large load from the backfill and the upper half of the bell gives way. At least, such breaks seem more common than any other type. Nevertheless, these breaks seem unaccountable unless possibly the pipe is weakened by overcalking where lead joints are used.

At the present time, 16-ft. and even 24-ft. lengths of lightweight cast-iron pipe are being offered on the market. An obvious advantage of longer cast-iron pipe is the saving in joints. There are, however, certain disadvantages, including the greater difficulty of making deflections in straight pipe without the use of specials. The question also arises in my mind whether these long pipes may not be more subject to breakage due to the development of a bell-hung condition, as above described, than is the case with pipe in 12-ft. lengths.

Better and More Durable Coating Needed for Both Cast-Iron and Steel Pipe

In my mind a question of importance, both in connection with steel and cast-iron pipe, is the matter of procuring a better and more durable type of coating than is now generally available. Coating is a matter of great importance, in relation to both the interior and the exterior of the pipe, particularly in the case of steel pipe.

Something like twenty years ago, in connection with the water supply of Utica, N. Y., I had sections of three different kinds of pipe laid in the same soil: cast-iron, ordinary riveted steel and ingot iron. These pipes were dug up and their external condition examined about a year ago, and all of them were in first-class condition with no evidence of any appreciable tuberculation or deterioration.

As to the matter of joints, I am satisfied that leadite or similar compound will make reasonably tight and very satisfactory joints for cast-iron pipe at a cost materially less than that resulting from the use of lead. Like lead joints, leadite joints must be made carefully by competent and experienced men if the best results are to be obtained. A disadvantage of the use of leadite or similar jointing material arises from the fact that the joint, even if it is a good one, will often show considerable leakage when it is first put under test. It often requires that the trench shall be left open for a week or two weeks in the case of a large pipe for the joint to set up to its normal degree of watertightness. This necessitates leaving the trench open longer than is generally desirable unless the engineer is willing to take a chance that a joint which appeared all right but shows the usual relatively high leakage to start will set up and become watertight in the course of a reasonable time.

In connection with the Albany gravity water-supply project I made a pretty thorough investigation two years ago relative to the various types of material, joints and construction available for a 48-in. supply conduit 20 miles in length. At that time I reached conclusions that better piping of various kinds could be produced than is now generally available. This statement applies not only to cast-iron pipe but to steel pipe and also to concrete pipe with a steel or ingot diaphragm. Owing to conditions of competition I did not find it easy to get manufacturers to bid on specifications which would, in my opinion, have produced better grades of pipe than the commercial articles now on the market. Standard cast-iron pipe is being used on this project.

Cast-iron pipe may be perfect as far as material is concerned, but if the ends are not in parallel planes, the axis of the pipe is not a straight line, or the pipe eccen-

ine, it is exceedingly difficult to lay it under certain conditions, particularly such conditions as were met two years ago in laying a 36-in. cast-iron force main in Albany—on which a break occurred July 31, 1929, as the line was being refilled after a brief shutdown to install a new check valve in the pumping station.

On this line the existing underground structures made it necessary to determine the position and alignment of the pipe with great accuracy beforehand, as the clearances in some cases were very small and there were definite limitations as to room available to support adjacent underground structures during and after the construction of the new pipe line. The same pipe laid in an earth trench in open country might have been laid with very little difficulty, as minor deflections and variations in size and form could easily have been taken up within the limits of the pipe trench, and the pipe if deflected in one length could have been brought back into line within the next few lengths. Without presuming to give the exact cause of the break already mentioned as having occurred in this force main, it may be stated that in addition to the location difficulties just outlined, the pipe, which was made in France, was not true and straight longitudinally. The Albany force main was perhaps an extreme example, but it certainly illustrates the desirability of accuracy in length, form and alignment of cast-iron pipe which are to be used in crowded situations.

It is my opinion that good results can be obtained along some of the lines in which developments are now being made in connection with various types of pipe and conduit for water-supply purposes, but just which of the present articles will be acceptable generally is not a matter which can be determined at this time.

Transverse Fissures in Rails; Their Cause and Prevention

THAT TRANSVERSE fissures in rails are caused by excessive wheel loads and that the remedy lies in finding some grade of steel which will best endure the strains are the conclusions presented by James E. Howard, engineer-physicist of the Interstate Commerce Commission, in his report on a rail failure on the Missouri Pacific Railway in 1928. His opinions in this respect are well known but are not in general accord with those of many railroad engineers, who consider that these fissures are attributable to some features in rail manufacture not yet clearly determined, that service in the track merely develops them to the point of fracture and that prevention lies largely in improved rail-mill practice. In advocating study of means to prevent or retard the formation of such fissures the report appears to overlook the extensive investigations by the American Railway Engineering Association, both independently and in conjunction with representatives of the rail mills. Detection of transverse fissures before they become visible has been made practicable within the past year or so by the Sperry device, now in service, which can be applied to new rails or those in the track. But while such detection is a highly important step, the prevention of such fissures is of much more importance, from the standpoint of both safety and economy. An abstract of Mr. Howard's summary of his report is given herewith, and reference to an earlier report of the same kind will be found in *Engineering News-Record* of July 29, 1920, pp. 165 and 192. —EDITOR.

WHEEL loads of motive power and equipment each overstrain the metal in the upper part of the heads of all rails. Theoretically and practically all rails are exposed to conditions which culminate in the destruction of the metal. Internal strain set up by the wheel loads is proof of this assertion. There is no known steel having properties which enable it to resist current wheel pressures without the introduction of internal strains. Strains have not been measured in 12 per cent manganese steel, due to the inability of machining this metal, but its inherent toughness has been destroyed at the immediate running surface of the rail by wheel loads, rupture ensuing.

Overstraining the running surface by means of wheel pressures necessarily introduces internal strains, lateral and longitudinal. The lateral component leads to mashed and split heads; the longitudinal component leads to transverse fissures. Since it is impossible to avoid these intense pressures, the practical question is what grade of steel will best endure them. That information must come from track records, from rails which have been exposed to the vicissitudes of service, intense impinging pressures, rapidly applied loads, vertical wave motions and longitudinal vibrations. There are two features which attach to manufacturing conditions—namely, shrinkage cracks in the central core of the head and longitudinal slag streaks or extended blowholes. Longitudinal streaks undoubtedly lead to the formation of compound transverse fissures, but further data are needed to demonstrate the influence of shrinkage cracks. These data must come from the examination of rails which have been in service.

Although repeated examinations have been made of the metal in the vicinity of transverse fissures and no foreign inclusion of any kind has been discovered nor any peculiarity in composition or structure, nevertheless a more intense study is desirable of these features. Fractures must have definte origins. What micro constituent is responsible for the inception of rupture? Internal strains are set up by heat or mechanical treatment. In treated and untreated steels what relations do the micro constituents bear to the points of inception of fractures?

Welded Joints Used in Long Oil Pipe Line

Bell and spigot joints sealed by the welding process were used throughout the entire length of an oil pipe line recently completed between Cushing, Okla., and the Chicago district. Throughout the 624-mile length of the main section of the line, terminating at Wilmington, Ill., 12-in. welded-steel pipe was used. At Wilmington the line splits into three branches which carry oil to East Chicago, Ind., and Lawrenceville and Lockport, Ill. The total length of branch lines is 200 miles. The same type of pipe was used in 10- and 8-in. diameters. At all major river crossings, including the Mississippi, the Missouri, the Arkansas and the Illinois rivers, extra heavy seamless pipe was used.

In joining the 40-ft. sections of pipe each weld was made in two beads to eliminate pinholes. Current was supplied by portable gasoline engine-driven welders drawn by horses or by tractors, depending upon conditions. Despite the fact that welding was carried on during the winter and spring, the average on the whole line was 10.3 welds in 12-in. pipe per man per day, with a maximum of 25 welds per man per day under favorable conditions. Each weld was thoroughly inspected and, in addition, hydrostatic tests were made of each section as completed, the pipe being placed under a pressure of 800 lb. per sq.in. In one 334-mile section only three pinholes were found as a result of this test.

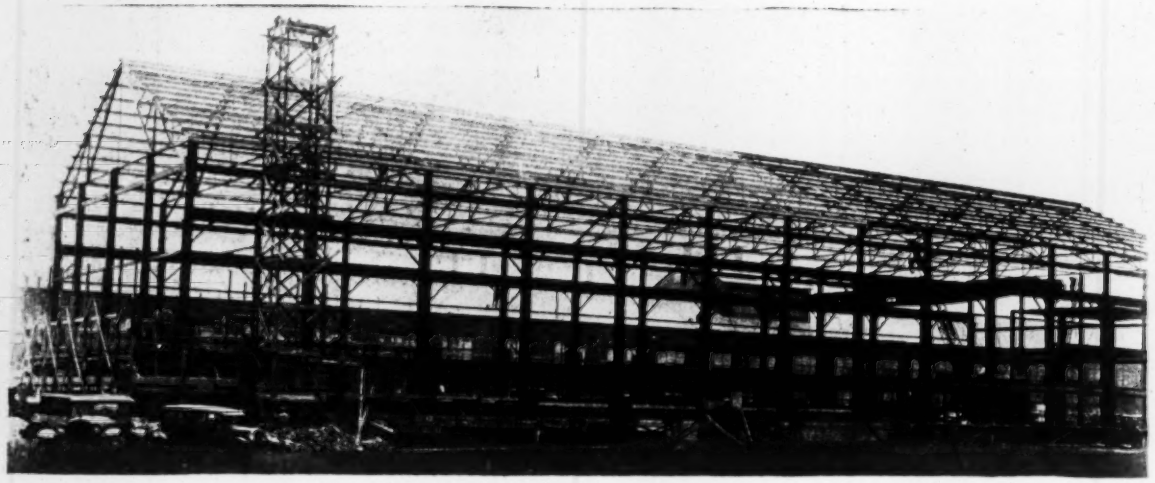


Fig. 1—Research Building at Niagara Falls, N. Y., Fabricated and Erected by Gas Welding

Gas-Welding Design and Erection on a 300-Ton Mill Building

Research Building at Niagara Falls Plant of Union Carbide Company Represents First Major Use of Gas Welding in Structural Field

By H. M. Priest and H. H. Moss

Assistant Engineer, American Bridge Company, New York City, and Engineer, The Linde Air Products Company, New York City

IN CONSTRUCTING the new research laboratory building for Union Carbide & Carbon Research Laboratories, Inc., in the Niagara Falls plant of the Union Carbide Company, oxyacetylene welding was utilized in place of riveting for all connections in the steel framing which would normally have been riveted. The character of the structure, which is the first building of major proportions upon which gas welding has been used, is shown in Fig. 1. The job involved approximately 300 tons of steel and in its construction embraced a wide range of connections. The methods employed for its design and construction are explained herein, while a second article will include certain economic data applying to this project which the authors developed from observation during the course of the work. The conversion in design for welded construction effected a saving of approximately 30 tons of steel, a substantial portion of this being obtained from the trusses.

The specifications for general design observe the requirements of the building code of the city of Niagara Falls, whereas the conversion design, involving welded construction, conforms to the recommendations of the structural welding code of the American Welding Society.

Description of Building

The building consists of a single unit 75 ft. wide by 260 ft. long composed of thirteen 20-ft. trussed bays 42 ft. 5 in. high between the main floor and the lower chords of the trusses (Fig. 2). Mezzanine operating floors 27 ft. wide extend along the entire westerly side of the building. In bays 1 to 11 there is one mezzanine, while in bays 12 and 13 there are three stories of mezzanine floors. The main floor and first mezzanine floor are served at present by a 10-ton traveling crane, although the steel is designed for a 20-ton crane, in case future operations require this additional crane capacity. The trusses are compound Fink in type, modified to the extent of having their principal compression members vertical instead of normal to the upper chord, a modification made for the purpose of reducing the over-all size of the half-truss to allowable shipping dimensions.

The connections in the north end bent provide for future building extensions. The side envelope is of common brick and steel sash, the latter comprising approxi-

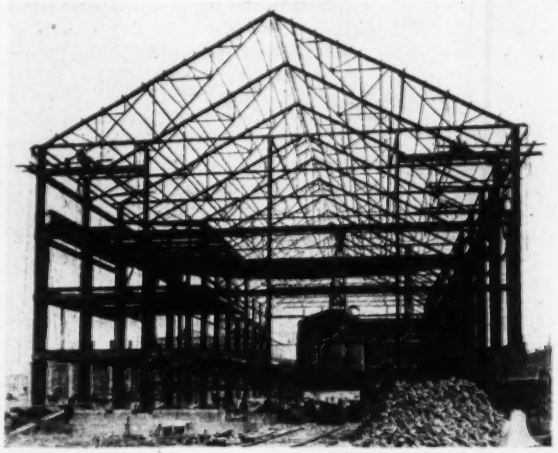


FIG. 2—END VIEW OF GAS-WELDED BUILDING AT NIAGARA FALLS

Mezzanine floors at left. Note workmen on hanging scaffolds, welding truss kneebraces

mately 50 per cent of the total wall surface. The roofing is 18-gage galvanized corrugated copper-bearing steel carried on 8-in. channel purlins. A standard-gage railroad enters the building through car doors provided in the south end, to facilitate the handling of heavy equipment and operating materials.

Design

Originally the building was designed as a riveted structure. It was selected by the Union Carbide Company as a suitable one for the substitution of welding because of the variety of problems which it offered in the way of studying and selecting details best suited to the gas-welding process. The determination of stresses and member sections followed usual practice. The welds were based on a unit shearing stress of 11,300 lb. per sq.in. The salient features of the building can best be brought out by descriptions of some of the individual details.

The heel of the roof truss illustrates the use of butt-welding, a method which is especially adapted to the gas process. The top and bottom chords were composed of halves of beam sections and at their junction the stems were welded along the horizontal joint. The stresses in the flanges were transferred through bars, as shown in the detail (Fig. 3), and a small stiffener plate was added on each side to strengthen the joint and to resist any tendency for the web to buckle. A bearing plate was welded on the end, and all holes for field bolting to the top of the column were placed in this plate, a detail which avoids the reduction in area common to all tension members in riveted construction.

The trusses were shipped in half-sections, so that a field splice was required at the peak. The pitch of the roof formed a natural vee between the square-cut ends of the flanges, which made a butt weld a simple and effective means of splicing. The vertical hanger served as a splice for the stems, being field-welded as shown in the detail (Fig. 3). In order to hold this joint in line during assembly in the field, a 3x3x$\frac{3}{8}$-in. clip angle was shop-welded to each half truss; field bolts pulled these clip angles tightly together and a weld bead was later run around the edges of the angles (Fig. 4). The fact that the flanges were welded across their entire width added materially to the lateral stiffness of the truss during erection. The bottom-chord splice plate was also utilized as a gusset plate for the horizontal rod bracing, and was shop-welded to the half truss.

FIG. 4—FIELD WELDING HIP JOINT BETWEEN TWO HALF-TRUSSES

Clip angles shop-welded to each half-truss provide means for holding trusses together during field welding. Operator is placing butt welds between flanges of the top chords. As a final operation a bead is run around the edges of the clip angles.

Calculation of Column Splice—The crane column splice (Fig. 3) was designed to resist the allowable bending moment for the upper section, a 14-in., 95-lb. beam. At a fiber stress of 16,000 lb. per sq.in., the moment on this section was 196,200 ft.-lb., so that the stress in the splice plate equaled 196,200 × 12/14.19, or 166,000 lb. The required area of the plate therefore was 166,000/16,000, or 10.4 sq.in., and 10½x1-in. plate was selected. With a working stress of 5,000 lb. per linear inch of $\frac{5}{8}$-in. weld, the length of weld required was 166,000/5,000, or 33.2 in. A weld length of 17 in. on each edge of the outside splice plate was used.

The plate on the inner flange of the 14-in. beam (Fig. 3) was slotted for the web of the lower section. Fillet welds of $\frac{3}{8}$ in. were used in the lower half of the

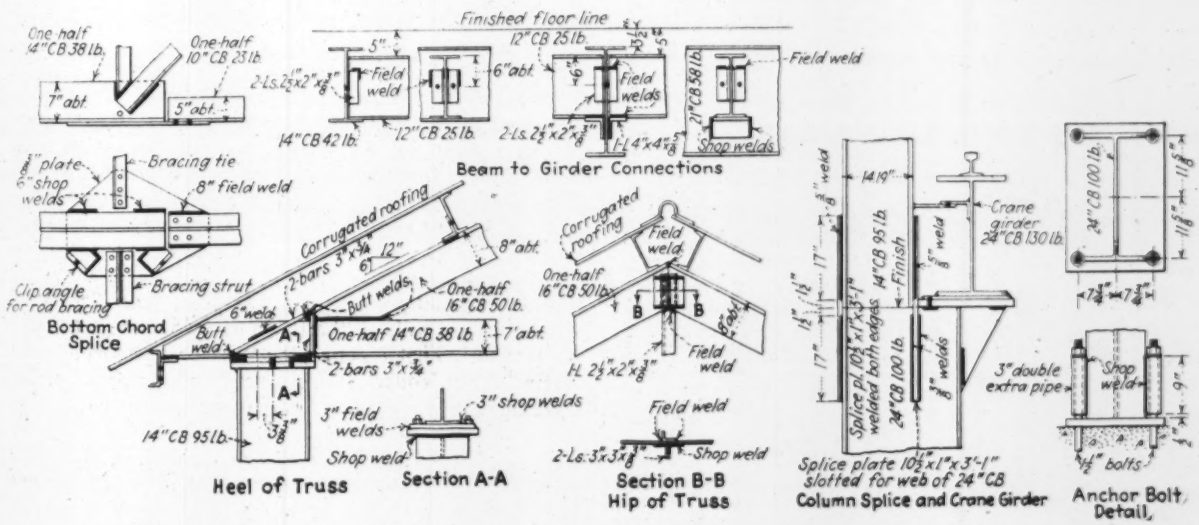


FIG. 3—DETAILS OF GAS-WELDED JOINTS, NIAGARA FALLS RESEARCH BUILDING

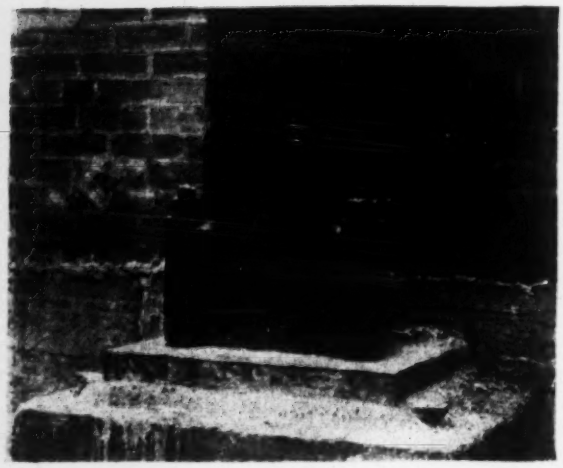


FIG. 5—ANCHOR BOLT DETAIL CONSISTING OF SHORT LENGTHS OF PIPE WELDED TO EACH FLANGE OF THE COLUMN

plate to bring the shearing stresses on the web of the lower beam, a 24-in., 100-lb. section, within safe working limits. All welding around this splice was kept 1½ in. back from the finished ends of the two sections so as to avoid heating the milled surfaces to welding temperature. Using a length of weld of 17 in., the shear on the web equals $166{,}000 \div [2 \times (17 + 1.5) \times 0.45]$, or 10,000 lb. per sq.in., which is satisfactory.

The crane girder was designed for a 20-ton crane. In order to avoid the use of a side channel (with the attendant welding) to resist the horizontal thrust, it was decided to use a wide-flange beam as shown in Figs. 2 and 3. The crane columns were designed on the assumption that the point of contraflexure would be one-third the way up from the base to the foot of the kneebrace. The resulting moment at the base was taken by the anchor bolts. The anchor arrangement, one of the unique details in the structure, consists of short sections of pipe welded to the edges of the flanges to form a boot (Figs. 3 and 5). The welding design assumptions for the anchor boot were checked by means of a number of destructive tests utilizing varying lengths of pipe.

Approximately 14 tons of steel was shipped directly from the mill, an economy made possible by the use of the beam and girder detail shown in Fig. 3, in which all shop punching is confined to the girder beams. The one-hole clip angles served as guides in spacing the

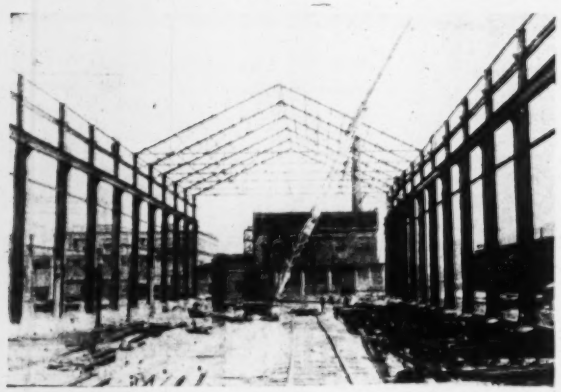


FIG. 6—LIFTING WELDED TRUSSES INTO PLACE ON NIAGARA FALLS BUILDING
Half-trusses were welded together on ground in position shown at right.

small beams and to hold them in place after erection. A small amount of field-welding was put on these angles to stiffen the floor construction.

An unusual amount of developmental work was occasioned by this job and this will be described in a subsequent article, which also will cover the shop fabrication of the steel.

Erection

The erection contract called for the bolt assembly of steel only, including the spotting of assembled trusses on the ground for the purpose of welding the field connections before erection. All field-welding was done by three operators selected from the shop crew and working under the direction of the Linde Air Products Company's construction welding supervisor. The work of erection was completed in approximately two weeks and that of welding in five weeks, welding having started two days after the erector began setting up.

The side columns and interconnecting side members, including the crane beams, were erected first, during which time the welders worked on the trusses on the ground. These were laid overlapping on one side of

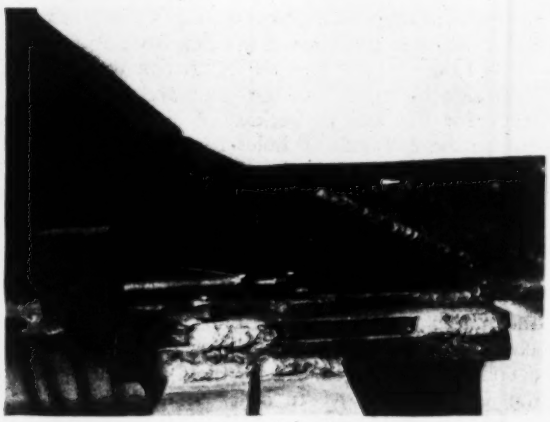


FIG. 7—FIELD-WELDED CONNECTION BETWEEN TRUSS HEEL AND COLUMN TOP

the main aisle of the building (Fig. 6), and no difficulty was experienced in making the vertical and overhead welds which the splicing of the trusses required. By the time the side framing was erected, practically all of the truss welding was completed. After the trusses were lifted into position and the bents plumbed, the welders were sent aloft to weld the truss heel (Fig. 7) and kneebrace joints, thence down each column for the details. One welder per section was found to be sufficient. Welding aloft impeded the welders somewhat at the start, and due to inaccessibility the rate of welding in the field was from 15 to 20 per cent slower than that obtained in the shop.

Welding gases were supplied in cylinders placed at convenient points from which the gases were conveyed to the welders through standard hose, the lengths of which varied from 50 to 150 ft. One-man plank scaffolds were used only about the columns below the truss-seat connection. The joints in the mezzanine flooring were reached from ladders. No warpage was encountered as a result of any of the field welding.

Welding Data

Theoretical weight data covering the steel used on this job are given in Table I, while Table II gives the amount of welding in linear feet for both shop and field work,

TABLE I—WEIGHT DATA FOR STEEL, NIAGARA FALLS GAS-WELDED BUILDING

	Total Weight, Inc. Bolts, Nuts and Washers, Lb.	Shipped Direct From Mill, Lb.	Unwelded, Lb.	Welded Shop and Field, Lb.
(a) Columns	163,467	.....	.....	163,467
Base plates	18,063	.....	18,063	.....
(b) Beams and girders	104,047	27,424	.....	76,623
(c) Crane beams	69,399	.....	.....	69,399
(d) Crane rails	14,700	.....	14,700	.....
(e) Purlins	73,357	.....	73,357	.....
(f) Mullions or girts, Bracing, Miscellaneous	74,469	.....	55,601	18,868
(g) Trusses	77,052	.....	.....	77,052
	297¼ tons	94¼ tons		202¼ tons

TABLE II—LINEAR FEET OF WELDING SPECIFIED FOR NIAGARA FALLS GAS-WELDED BUILDING

	Shop	Field	Total
¼-in. fillet welds			
Trusses	1,062	187	.....
Beams	.....	367	.....
Mullions, kneebraces and misc.	313	357	.....
Columns	1,108	.....	.....
	2,483	911	3,394
⅜-in. fillet welds			
Columns	344	11.5	355.5
½-in. open butt welds			
Crane beam braces	8	.....	.....
Trusses	61	.....	69
½-in. single vee butt welds			
Trusses	35	8	43

classified as to size and material involved. The weight of welding rod consumed by fillet and butt welds in pounds per linear foot of weld was as follows:

Size of Weld for Fillet Welds Thickness of Material for Butt Welds, In.	Fillet Welds	Butt Welds— Single Vee	Double Vee
1/4	0.14	0.30	.....
3/8	0.32	0.70	.....
1/2	0.56	1.22	.....
5/8	0.88	1.95	0.90
3/4	1.27	2.90	1.25
7/8	1.74	.....	1.70
1	.....	.....	2.30

The building proper was designed by the Union Carbide Company's engineering department under the direction of H. L. Noyes, chief engineer. The steel framing was redesigned for welding and fabricated by the American Bridge Company, under the direction of J. H. Edwards, chief engineer, assisted by the development section of the engineering department of the Linde Air Products Company under the supervision of F. J. King, chief engineer. The field erection, consisting of bolt assembly of the steel framing only, was performed by George C. Holcombe, of Buffalo and Forestville, N. Y. The field-welding was done by the owner's construction force under the direction of the development section of the Linde Air Products Company.

Airplane Designed for 43-Ton Landing Shock

The new eighteen-passenger Boeing airplanes built for passenger service between San Francisco and Chicago have a gross weight, loaded, of 8¾ tons and the landing gear has been designed to sustain this weight with a safety factor of five. Department of Commerce regulations require that the design of such ships shall provide for a landing factor involving an 18-in. drop, which is considerably more than should be involved in normal landings. As a safety measure, however, the new Boeing plane is designed to withstand a landing shock of 87,500 lb., calculated as the equivalent of a 23-in. drop. The tires have a height of 4½ ft. and a width of 1 ft. Each wheel is provided with a heavy shock-absorbing device operating on the dashpot principle.

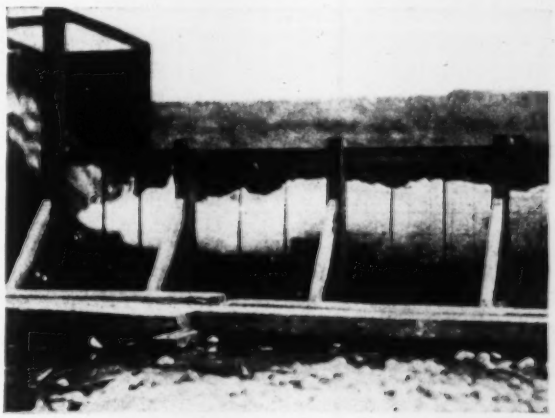
Tests on Model Dam Determine Baffle Weir Design

Best Hydraulic Jump for Bridge River Dam Obtained With Vertical Face—Scour Recorded in Sand Layer on Bottom

By C. E. Blee

Principal Assistant Engineer, Construction Department, British Columbia Electric Railway Company, Ltd. Vancouver, B. C.

THE diversion dam to serve the initial stage of the hydro-electric development now being carried out on Bridge River by the British Columbia Electric Railway Company, Ltd., will be an overflow dam of rockfill timber crib construction. Ultimately this will be replaced by a high rockfill dam located just downstream from the initial structure. In the dam now being built it was desirable to make sure of avoiding streambed erosion below the toe. It was therefore decided to use some form of energy-dissipating device on the downstream face, and in order to compare results with various designs, experiments were carried out with models built to simulate the overpour section of the dam. Results of a series of tests made with models built on a 1:12 scale are given in the following:

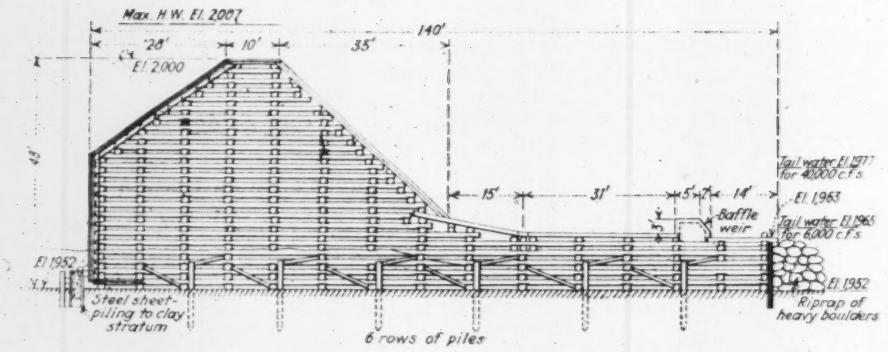


BEST BAFFLE WEIR LOCATION, FLOOD FLOW
Model is on 1:12 scale representing 40,000 sec.-ft. flow. Note squares marked on plate glass.

The crest of the timber crib dam will be 48 ft. above streambed and is designed to pass a maximum flood of 40,000 sec.-ft. The length of the spillway crest will be 650 ft., giving a crest depth in maximum flood of about 7 ft. The section proposed for the dam is largely dictated by the timber-crib type of construction and will consist of a broad crest and a downstream slope of approximately 1:1 connecting with a fillet to a log apron terminating in a riprap of heavy boulders.

The foundation is sand and gravel overlying an extensive bed of clay located about 40 ft. below streambed. A cutoff will consist of a row of steel sheetpiling along the heel of the dam extending into the clay stratum. A row of sheetpiling also will be driven at the downstream end of the apron to serve as a barrier against undercutting.

Developing the Hydraulic Jump—Early in the development of plans for this project it was recognized that the depth of tailwater below the dam would have an



SECTION OF TIMBER-CRIB DAM FOR BRIDGE RIVER PROJECT

important bearing on the problem of protecting the streambed against erosion. With this in view, gages were established along the river and profiles of the water surface were plotted over a wide range of discharge. These profiles showed that a natural control, which would not be affected by the dam, existed a short distance downstream from the site. From the water profiles it was then possible to determine, within reasonable limits, the tailwater elevations which would obtain for any discharge over the dam.

Computations were made of the hydraulic jump under various assumptions, and these showed that with the apron of the dam depressed as far as practicable, there would not be a sufficient depth of tailwater at low discharges to induce a hydraulic jump.

However, with the timber crib type of dam the hydraulic jump appeared to be the most practical method of dissipating the energy of the falling sheet of water. The problem then was to determine (1) the best form of baffle weir and (2) the minimum height of weir which would afford desirable control for the low flows and give a sufficient water depth on the apron to induce the hydraulic jump; also (3) the limiting distance which the weir could be moved upstream toward the toe of the dam and still perform its function of inducing the hydraulic jump. This latter determination was of importance, as it affected directly the length of apron required.

Planning Use of Models—The best method of studying these problems appeared to be with the aid of a model, and this plan was accordingly adopted. The problem of where to build the model was largely a question of water supply. Metered water from the city mains would have cost 6c. per 100 cu.ft., which was prohibitive. It was finally decided to make the tests at the spillway of the company's Alouette dam, where water could be drawn from the lake through an opening closed by stoplogs, the lake level varying from 10 to 15 ft. above the spillway floor. Living quarters were available there and the place is reasonably accessible from Vancouver.

A scale of 1 in. to the foot was selected, giving a model 40 in. high, which worked out very satisfactorily. With dams involving much greater heights probably a smaller scale would be necessary. A width of 36 in. was decided upon for the model, thus representing a section of the dam 36 ft. long measured along the spillway crest. Experience with the model in operation indicated that 36 in. is about the least width that should be used, since the flow adjacent to the sides of the model is noticeably affected by friction.

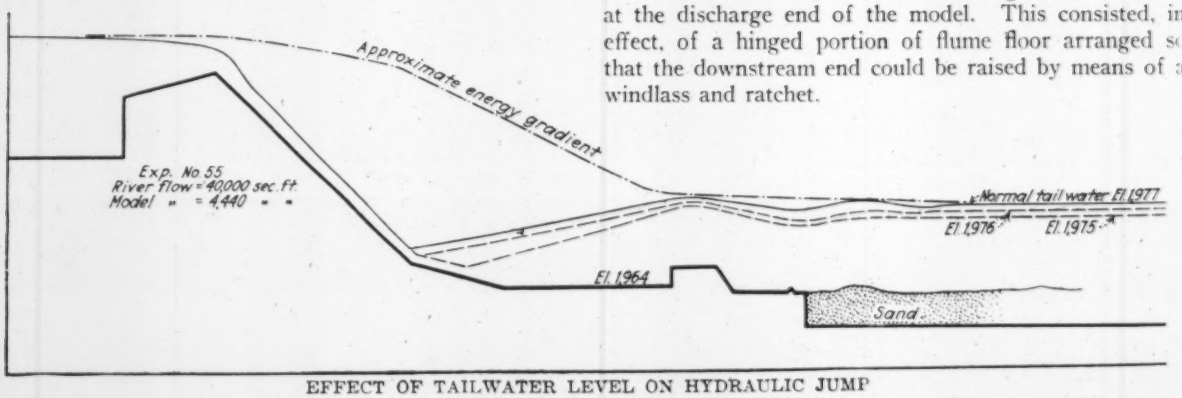
Model Design—Water was conveyed by flume from the stoplog opening of the Alouette spillway to a stilling chamber ahead of the measuring weir. Side spilling gates were installed in the flume and in the stilling chamber, and by adjusting these in connection with the rather crude headgate the quantities of water passing over the weir could be regulated as desired.

A float gage was installed in a stilling well above the weir, another above the crest of the dam, and a third below the dam to measure the height of the tailwater. To smooth out the flow as much as possible, rather elaborate systems of baffle boards were located by trial above the measuring weir and also above the crest of the dam.

The model and flumes were built entirely with tongue-and-groove flooring. The portions representing the crest and downstream face of the dam were carefully dressed and oiled. Although the actual structure will have comparatively rough surfaces, it was felt that the surfaces of the model were possibly somewhat rougher than they should have been to represent properly the full-scale conditions.

One side of the model was constructed of ¼-in. plate glass. The glass was ruled off in squares, which were found very helpful in locating and sketching points on the water profile under various flow conditions. The floor of the model beyond the apron was covered with screened sand, upon which the flowing water left a very interesting and instructive record.

To control the tailwater elevation a gate was installed at the discharge end of the model. This consisted, in effect, of a hinged portion of flume floor arranged so that the downstream end could be raised by means of a windlass and ratchet.



EFFECT OF TAILWATER LEVEL ON HYDRAULIC JUMP
Illustrates form used to record results of each test.

Test Sequence—Many series of tests were run with various forms and locations of baffle weir and other variables, each series being taken through a range corresponding to flows of 6,000 to 40,000 sec.-ft. on the full-size dam.

Three men generally operated the model. One changed the setting of the main headgate, another adjusted the wastegates to give the exact weir discharge desired and the third adjusted the hinged discharge gate to give the correct height of tailwater.

The outstanding impression of the tests was the speed and facility with which the river, in miniature, could be put through all its paces from low discharge to maximum flood. When running through a series of tests just for observation and review, without recording, the entire range representing flows of 6,000 to 40,000 sec.-ft. could be covered in fifteen or twenty minutes.

The ordinary routine for each stage of flow included sketching the profile of the water surface, locating the position of the hydraulic jump, sketching the profile of the sand surface below the apron, when this had reached a stable position, also making notes as to the action on the sand and other facts observed. A photograph was made of each stage and a number of reels of motion pictures were taken. Both the stills and the movies proved of much value in reviewing and studying the hydraulic effects.

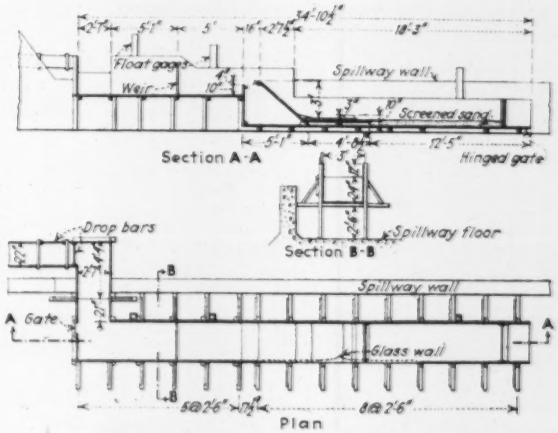
Results of Tests—The tests were started with a baffle weir having a height corresponding to 3 ft. above the apron and with a sloping upstream face. For flows of from 11,000 to 25,000 sec.-ft. this weir did not form a sufficient control to induce the hydraulic jump. The high velocity carried through to the weir, where the sheet of water, impinging on the weir, was thrown high into the air.

Further experiments showed that a 4-ft. weir with inclined face would satisfactorily control the pool on the apron and produce the hydraulic jump, but it later developed that a 3-ft. weir with vertical upstream face was fully as effective as the 4-ft. weir with inclined face. The lower weir was preferable, as it caused less disturbance at the higher flows and gave that much less height to drop the overflowing sheet of water at low flows when the tailwater is below the apron elevation.

A weir having a re-entrant curve on the upstream face and shaped like the typical wave-deflecting seawall proved no more effective than the vertical-faced weir. Tests also were made with a weir of dentated form in which alternate sections were depressed. It was necessary to modify this shape so as to control the low flows sufficiently, and these modifications reduced to some extent the effectiveness of the dentated weir. This form of weir gave somewhat smoother flows, particularly at the very high discharges, and tended to diminish the upstream roll or back eddy below the weir. However, for the particular conditions and the form of construction being considered, it was believed that the improvement in flow conditions was hardly decisive enough to warrant the more difficult construction.

With the form of weir tentatively adopted—namely, a 3-ft. weir with vertical face—experiments were made to determine to what extent its location could be safely moved forward toward the toe of the dam. It was the high discharges that formed the critical conditions with the weir forward. In the forward position there was a tendency to disturb the flow and produce an upward deflection in the water profile over the weir. As the movement forward was continued, the higher velocities striking the face of the weir deflected the water upward still more and finally produced an undesirable standing wave.

At the start of the test to determine best location, the weir was a distance of about 4½ times the height of the jump from the point on the slope of the dam where the jump formed. As a result of the tests the weir was moved forward to a distance of approximately 3½ times the height of jump, resulting in a saving in length of apron of about 12 ft. It would be difficult to express this limiting distance in any general term other than to



ARRANGEMENT OF FLUMES, MODEL DAM AND BAFFLE WEIR

say that apparently it can be made considerably less than the "length of the jump," which is generally assumed as five times its height.

In the final series of tests run on the tentatively adopted form of structure, the tailwater was lowered below the predicted levels to make sure that flow conditions would still remain satisfactory under these altered conditions. For the lower discharges, the level was lowered an amount corresponding to 1 ft. at full scale and for the higher discharges this amount was increased to 2 ft. It was felt that these amounts covered any probable variation from the predicted levels.

Conclusions—The Bridge River dam has not as yet been constructed, so there has been no opportunity to compare the action of the model with the full-scale structure. However, as to the depth of tailwater required to produce the hydraulic jump under various discharges and the location of the jump, the results found on the model check so closely with computed data that no question is entertained about the behavior on the actual structure following the same laws. The quantitative effect of erosion over long periods of time are not so readily appraised. The portions of the natural streambed composed of the finer particles will undoubtedly be eroded to an extent greater than that indicated by movement of the sand in the small-scale model, but not, it is believed, to any such extent that erosion cannot be prevented by the heavy riprap contemplated.

First Skyscraper for Germany

The sixteen-story hospital now under construction at Schwabisch Hall, Germany, will be the first of the skyscraper type in that country and will be the largest and most modern hospital in Europe.

Reconstruction of Table Rock Cove Earth Dam After Dangerous Washout and Slump

Sluiced-Core Embankment Used to Fill and Reinforce Washed-Out Gorge and Slumped Area—Broken 42-In. Pipe Line Filled With Concrete and Puddled Clay

By S. T. Henry
Southeastern Representative, Engineering News-Record

FIG. 1—FILLING IN SLUMPED AREA OF TABLE ROCK COVE DAM, GREENVILLE, S. C.
Note steep banks of sloughed portion, shown at left.

ON MAY 4, 1928, the Table Rock Cove dam of the Greenville (S. C.) water-supply system, containing about 600,000 cu.yd. of earth, was nearly lost by a washout on the downstream face due to the failure of a 42-in. Class D cast-iron drainage pipe passing through it in a trench along the bank of the stream. A summary of what had occurred up to May 8 was given in *Engineering News-Record*, May 10, 1928, p. 750.

The principal features of the original dam are shown in Fig. 2. The embankment is across a narrow valley with a crest height of 140 ft. above the bed of the stream. The upstream face is on a 1:3 slope up to 35 ft. below the crest, and thence on a 1:2½ slope to the top. The water line at the spillway crest level was 10 ft. below the top of the dam, the latter having a width of 28 ft. The downstream face was on a uniform 1:2 slope.

Most of the embankment consists of a finely divided red clay excavated from adjacent borrowpits by power shovels and delivered to place in trains of narrow-gage cars. Particular pains were taken to secure only a red clay which was free from rock or gravel. The material was side-dumped from the cars and then spread by road-grading machines in layers averaging about 6 in. thick. Each layer was well compacted by road rollers. A cutoff trench in the hardpan and rock bed at the site made a key for the base of the embankment. No core of any kind was provided, nor was any hydraulicking done during the placing of the fill to obtain segregation of the fine and the coarse materials, or to hasten settlement. The resulting structure, therefore, was quite impervious and provided no drainage path for such waters as finally found their way to the downstream slope.

The 42-in. cast-iron pipe, in 12-ft. lengths, was placed to bypass the stream during construction of the embankment. It also was to serve for draining the reservoir as required. This pipe was laid in a trench excavated, for the most part, in rock. On an average spacing of about 55 ft., but varying from 40 to 95 ft., concrete cutoff walls, 18 in. thick, were built across this trench and surrounding the pipe. Between the cutoff walls the trench was backfilled with earth tamped around the pipe.

One valve was placed at the downstream end of the pipe. The upstream end was open to the pond without any regulating device. The location of the 42-in. pipe, its method of support and, particularly, the location of the valve on this pipe had a very important bearing on events at the time of, and subsequent to, the sloughing of the downstream slope.

The dam was under construction for about two years. Because of scanty rainfall, the reservoir, with a capacity of 28,000 acre-ft., had never filled. Shortly prior to the accident, however, heavy precipitation had raised the level of the pond to within 15 ft. of the spillway crest, or 25 ft. below the dam crest.

Immediately previous to the washout there had been some slight seepage in spots on the downstream face. With one exception these were well above the level of the 42-in. drainage pipe. There was a wet spot around the concrete chamber of the valve at the downstream end of that pipe, but this was believed traceable to a spring whose original location was near that point. There had also been previous evidence of a fairly heavy flow of water from the hillside above into the end of the embankment adjacent to the slide.

The failure occurred suddenly in the shape of a blowout near the toe of the downstream face of the dam a short distance above the valve chamber. For a distance of more than 150 ft. the rush of water from a break in the pipe cut a deep, narrow trench in the embankment. Thence the downstream slope slumped away in a break that extended to beyond the crest as shown in Fig. 2.

The bottom of the slumped area was nearly flat and was at or near the original bed of the site. The break was in the shape of an irregular arch having a face slope ranging from 1 : 1½ to nearly vertical. Practically all of the movement occurred in a few hours. There was limited subsequent slipping of small masses of loosened material soon after the first slump. In the main, however, the steep faces of the break stood unprotected for many months pending emptying of the reservoir and repair.

Whether the water was following along the 42-in. pipe or was issuing from a break in the pipe could not at first be definitely ascertained, and it was not until some time later than an actual hole in the pipe could be found.

Reference to Fig. 4 will show that this hole, or main break, was about 160 ft. upstream from the downstream end and valve. Emergency attempts to stop the break with broken stone, sand bags and various material served only completely to fill the entire 160 ft. between the break and the valve. The valve was of no service in the subsequent drainage of the pond, nor was it, in fact, a factor at any stage.

To review the facts of the case and to suggest remedial measures, there was appointed a board of consulting engineers, consisting of W. S. Lee, J. E. Sirrine and J. L. Ludlow. The findings of this board were published in *Engineering News-Record* July 19, 1928, p. 109. Thereupon W. S. Lee, consulting engineer, of Charlotte, N. C., was retained by the city of Greenville to carry out the rehabilitation of the dam.

A large hole visible in the 42-in. drain pipe suggested the possibility of other damage elsewhere in this pipe. The first step of the reconstruction was, therefore, an inspection of this pipe. This could not be done until the entire pond had been drained off. Even then, however, the pipe was still carrying the normal flow of the river. To take care of this flow a cofferdam with a sluice gate was built around the intake end of the pipe so that two or three days' run of the river could be impounded while the pipe inspection and other work were in progress. When the backed-up water rose to the top of cofferdam, the sluice gate was opened, all work in the pipe was discontinued and the pond was drained through the pipe.

A detailed inspection was made by one of the engineers crawling through the entire length of the pipe. Results of his inspection are shown in Fig. 4. The upstream portion of the pipe for a distance of 192½ ft. was found to be sound and undisturbed. The lower end of this 192½-ft. section is 270 ft. upstream from the upstream edge of the crest of the dam. It was, therefore, not subjected to the strains imposed on that part of the pipe under the maximum section of dam. At 192½ ft. from the inlet the ends of two sections of the pipe were 6 in. apart horizontally. In a distance of 438 ft. from this gap to the main break in the blowout all except eight of the 36 sections of pipe were more or less badly damaged.

Without exception it was found that the pipe had sagged between the concrete cutoff

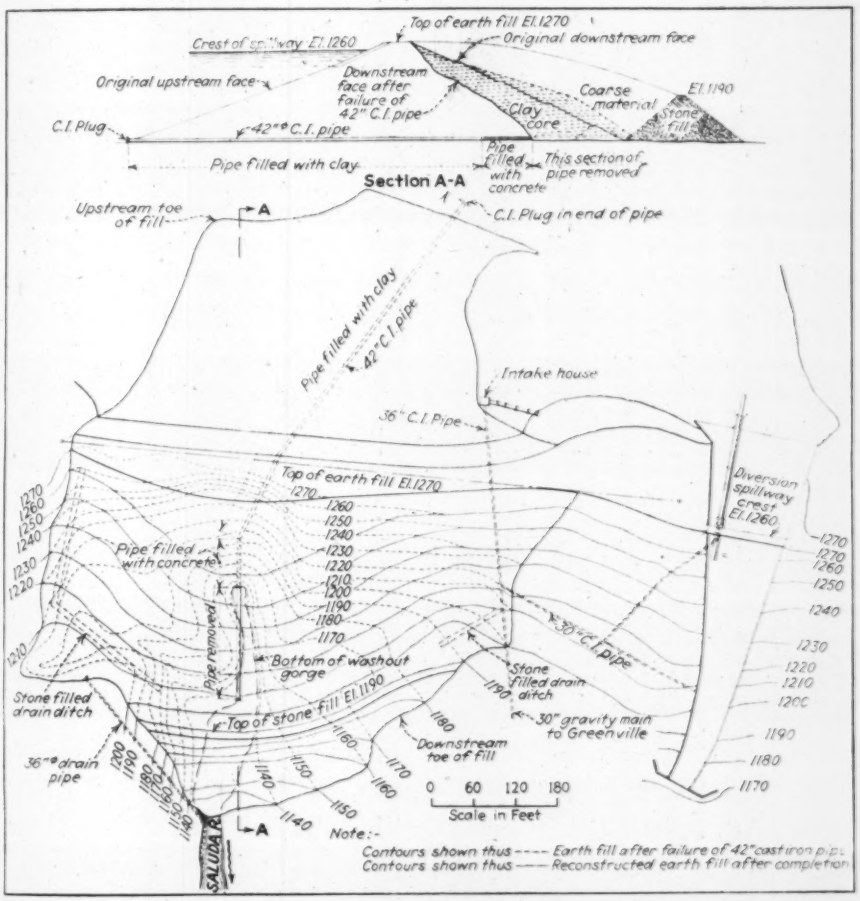

Top of earth fill El. 1270
Crest of spillway El. 1260
Original downstream face
Original upstream face
Downstream face after failure of 42" C.I. pipe
Coarse material
El. 1190
Clay core
Stone fill
C.I. Plug
42"ø C.I. pipe
Pipe filled with clay
Pipe filled with concrete
This section of pipe removed
Section A-A
C.I. Plug in end of pipe
Upstream toe of fill
A
Intake house
36" C.I. Pipe
Top of earth fill El. 1270
Diversion spillway crest El. 1260
Bottom of washout gorge
Stone filled drain ditch
30" C.I. pipe
30" gravity main to Greenville
Top of stone fill El. 1190
Downstream toe of fill
36"ø drain pipe
Stone filled drain ditch
Pipe removed
0 60 120 180
Scale in Feet
SALUDA R.
Note:-
Contours shown thus ---- Earth fill after failure of 42" cast iron pipe
Contours shown thus —— Reconstructed earth fill after completion

FIG. 2—PLAN AND SECTION OF DAM AFTER RECONSTRUCTION
Dotted contours on plant show shape of fill after slumping. Slumped area is indicated by these contours at left side of downstream embankment.

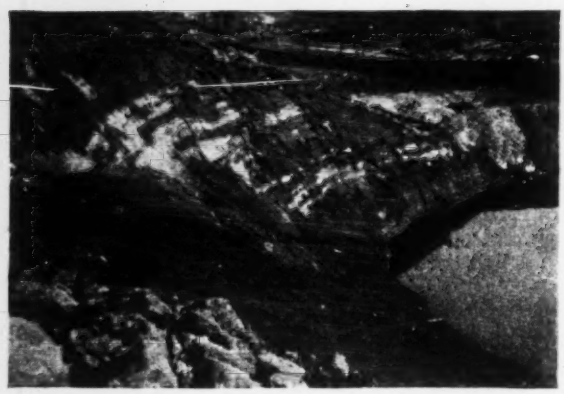


FIG. 3—SLOPE OF ORIGINAL EMBANKMENT AFTER BREAK

walls. The top of the pipe joint at each wall was invariably open, in one case as much as 2 in., while the bottom of the joint was tight, or at least tighter than the top.

The damage to the pipe took various forms. In general, it would appear that there was sufficient movement locally and as a whole in the embankment during the placing of the fill to cause the rupture and misplacement of the pipe. Some pipe lengths were cracked both top and bottom. Seven, at a point about midway under the upstream slope, were badly broken, with four somewhat uniform cracks on the horizontal and vertical axes. Directly under the crest an irregular triangular piece of pipe had fallen entirely out into a cavity below the invert. Since this break was 12 in. wide at the base and about 48 in. long, the gap was easily vital.

Near this rupture there were three sections broken in four places similarly to those mentioned before, except in these cases the section of the pipe was partly flattened so that vertical height was only 26 in. From there on nearly to the main break there were cavities almost continuously, ranging from 6 to 17 in. deep and of undetermined width, wherever inspection could be made through the breaks. What has been previously referred to as the main break was found to be a triangular piece 30 in. wide at the base and 6 ft. long, which had been entirely carried away from one side of the top.

From the inspection it was apparent that in addition to plugging the upstream end of 42-in. pipe, the latter and the cavities around it would have to be filled completely and permanently to prevent future seepage flow through or along the pipe and further internal movement of the embankment or further rupturing of the pipe. To repair the break in the downstream face of the embankment, it was decided to construct a clay core backed up at the downstream toe by a heavy rockfill, with an earthfill of coarse material above the rockfill and inclosing the clay core.

The first step taken was to seal the upstream end of the 42-in. drainage pipe. This was done with a close-fitting cast-iron plug made with holes for one 4-in. and one 6-in. pipe, the purpose of which is explained later.

The next step was to plug with concrete the 42-in. pipe for a distance of 60 ft. upstream from the main break in the pipe. This 60-ft. length of pipe was divided into sections by wooden bulkheads and filled with concrete mixed on top of the dam and conveyed to place by gravity through a 4-in. pipe. Pieces of 1-in. pipe inserted in the top of each section served first as air vents and later as grout pipes to fill any space left by shrinkage of the concrete.

Downstream from the end of the section plugged with concrete the 42-in. pipe was completely removed. Carefully selected puddled clay was used to fill and seal the rest of the 42-in. pipe and the cavities surrounding it in the embankment in the following manner:

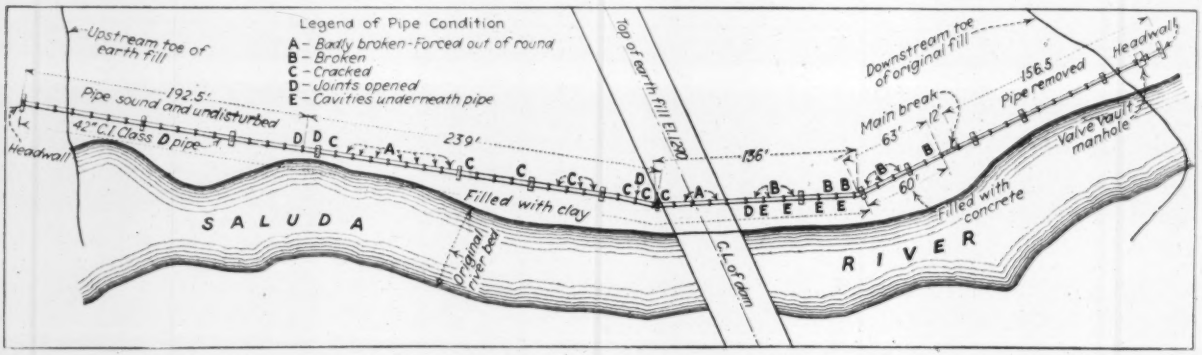


FIG. 4—CONDITION OF PIPE SECTIONS AFTER BREAK
Lower section of pipe removed before reconstructing fill. Lower portion of remaining section plugged with concrete, upper section filled with puddled clay.

A 6-in. pipe was inserted into the cast-iron plug in the upper end of the 42-in. pipe. This 6-in. pipe was then extended up the slope of the upstream face of the dam to the crest. A 4-in. pipe, leading from the cast-iron plug, was also extended up the upstream face nearly to the crest.

The material for the seal was obtained from adjacent

FIG. 5—RECONSTRUCTION APPROACHING COMPLETION
Large cracks in left foreground are at top of slump in original embankment.

borrowpits, where it was washed in a manner that would remove all sand and gravel and leave only the most finely divided clay particles. The clay was then mixed with water by hand in a mortar box and fed into the top of the 6-in. pipe. The carefully puddled clay used, while not exactly colloidal, did go very completely into suspension. The gravity head of 140 ft. on the water carrying it into the 42-in. pipe was sufficient to force the clay well into place in the beginning. In fact, it would probably have been sufficient for the entire operation, but later air pressure up to 100 lb. was turned on the 6-in. pipe.

Until the pipe became filled, the 4-in. pipe vented air only. After the pipe was full, however, the discharge from this vent was a mixture of clay and water, usually with a higher water content than that of the material

FIG. 6—SLUICING CORE FOR RECONSTRUCTION FILL

injected, showing that a real deposition of the clay in the pipe was obtained. During the last stages of this process, when 100 lb. of air was introduced in the 6-in. feed pipe, a solid plug of clay would be forced up through the vent pipe. Both of these pipes were left in place, full of clay.

In the first stages, charges of clay were put in as fast as a small crew of men could readily work. As the clay began to fill the pipe and cavities, less and less speed was made until, toward the end, some days would elapse between charges.

Working in this manner, there was evidence that the damaged 42-in. pipe and the surrounding cavities were entirely filled. The resulting seal was considered to have an advantage over concrete, in that the clay would follow any possible future movement of the pipe without destroying the seal or forming voids.

As soon as the cast-iron plug was placed in the upstream end of the 42-in. pipe, the reservoir began to fill. It was therefore necessary to start placing the clay core and the inclosing earthfill used to repair the break in the downstream face of the embankment.

A fill of loose rock, having a maximum depth of 50 ft. and a crest width of 12 ft., with slopes of 1:1 on both faces, was placed first across the valley to form the toe of the new earthfill and clay core. A mixture of coarse and fine materials was then dumped from motor trucks along the top of the upstream face of this rockfill and was subjected here to the action of water from a fire hose nozzle.

Working across the valley in this manner, a pool was formed in which was accomplished an excellent segregation of the clay from the coarse material. The clay core, as segregated, assumed a sharp-pointed oval shape, in plan, with the short axis perpendicular to the dam and roughly coincident with the up- and down-stream axis of the slide.

In this way the coarse fill was carried up ahead of the clay core. The core was brought up to the elevation of the maximum line of flow in the reservoir. The coarse material seal over the core has very flat slopes on its face, giving a much greater section than the original embankment. The total of the material placed in closing the break was, in fact, about 280,000 cu.yd., as compared with an estimated loss of 60,000 cu.yd. from the washout.

Following the completion of the repairs to the embankment, steps were taken to insure the saturation of the old fill. Sixteen 1-in. pipes were jetted down into the embankment at varying intervals, but more closely together in the vicinity of the top of the break. These pipes also were sunk to varying depths, ranging from 20 ft. to the bottom of the embankment. Water was slowly forced into them under 25-lb. pressure at increasing intervals. None of the pipes would admit any important amount of water, some taking practically none.

Prior to this saturation, operation benchmarks were located close to the top of the pipes. Readings on these made from time to time have disclosed practically no subsidence. Nor is there any evidence that any movement occurred in the embankment at any point as a result of the exceptionally heavy rains that occurred in the vicinity of the dam in September and October of this year. Water has now been standing 15 ft. below the spillway crest or higher for nearly six months.

Hetch Hetchy Water Supply to Be Delivered in Three Years

A REVIEW of the present status of the Hetch Hetchy project was made by M. M. O'Shaughnessy, city engineer of San Francisco, at the recent annual meeting of the California Section, American Water Works Association. The water supply from the new source should be available in the city, he said, about three years hence if no unexpected delays are encountered in the Coast Range tunnels which are now being advanced from fourteen headings. The three years allows two years for completing the tunnel driving and one year for placing concrete lining. The Hetch Hetchy project, which is to bring a 470,000,000-gal.-daily supply from storage reservoirs in the high Sierra 168 miles from San Francisco, is now 70 per cent completed. A review of construction progress up to that time appeared in *Engineering News-Record*, April 19, 1928, p. 614.

To date $58,000,000 has been spent on the project and $20,000,000 more will be required to finish the work now laid out. Only two major features remain to be completed—namely, the Coast Range tunnels totaling 28½ miles (of which 6½ miles had been driven on Oct. 15) and the 47-mile pipe line across San Joaquin Valley.

The Hetch Hetchy engineering staff recently has concentrated attention on the subject of pipes. The first 47-mile pipe line across the San Joaquin Valley is to be 5 ft. in diameter; two more lines of approximately the same size are to be added later when the increase in demand makes them necessary. Whether this pipe will be steel, or concrete and steel in combination, is now being studied. There is ample head for the pipe line across the valley, the elevation on the Sierra side being 700 ft. and on the coast side, 400 ft.

First Two Activated-Sludge Plants in Japan

Nagoya Building Large-Sized Works to Include Presedimentation and Spiral-Flow Diffusion, With Sludge Piped to Sea

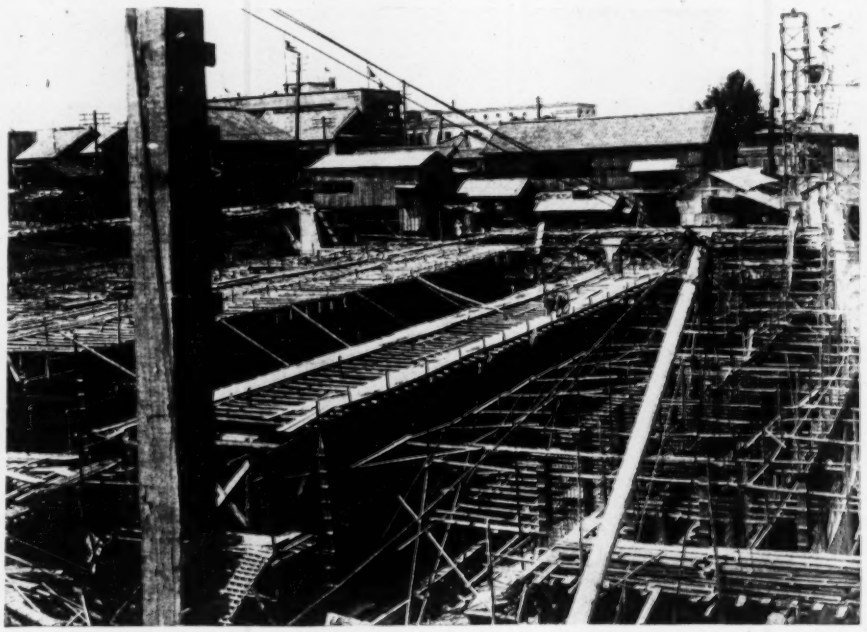
By Tsunejiro Kawahara

Civil Engineer in Sewage Disposal Office, Nagoya, Japan

SEWAGE disposal in Japan is still mostly in a primitive state. An exception to this will soon be afforded by Nagoya, a city of 1,100,000 population, where two activated-sludge plants are now under construction. These will be the first of the kind in Japan, except for small-scale experimental plants.

The sewage catchment area of Nagoya has been divided into three major sewage-treatment districts, in two of which sewage-works are being constructed and will be in full operation within about a year. Of these plants, that known as Horidome will have a capacity of 11,000,000 gal. a day, while the other, known as the Atsuta plant, will have a capacity of about 4,700,000 gal. daily. (American gallons are used throughout this article.)

Horidome Plant—The site for the Horidome plant is on low land in the middle part of this city, at the outlets of trunk sewers from the northern and eastern parts of the city. The grit chambers, presettling tanks and aeration tanks are inclosed in a building 15 ft. high to the ceiling, ventilated by a chimney-like tower carried 100 ft. above the level of the adjacent roadway, the tower having a height of 145 ft. above its foundation. The roof of the building is on a level with the highway and has been made into a small park.



PORTION OF HORIDOME ACTIVATED-SLUDGE PLANT, NAGOYA, JAPAN, UNDER CONSTRUCTION

This plant will have a capacity of 11,000,000 gal. daily, be roofed over and provided with a ventilation shaft 100 ft. above the level of the adjacent roadway. View taken July 29, 1929.

The plant covers an area of 2.5 acres. It is to handle mainly domestic sewage from an area of 5.01 square miles, including the civic center zone of this city. The plant is designed for 300,000 people, with a capacity of 11,000,000 gal. of raw sewage per day in dry weather, and three times that quantity in wet weather. There are two grit chambers, each having two compartments; six preliminary settling tanks; two open conduits leading to the aeration tanks; eight aeration and four reaeration tanks; sixteen final settling tanks; two sludge-storage tanks. Besides, there are a sewage-chamber capable of holding three times the dry-weather flow, and a pumping and air-blower station.

After being screened and presettled the sewage is to be aerated in a flat-bottomed tank, each unit of which consists of three channels 7 ft. wide and 156 ft. long, having effective depth of 15½ ft. To give spiral flow the filtros plates (12x24 in.) are placed at one side of the channels. The channel walls support the roof columns. Air is supplied at the rate of 2 cu.ft. per gallon, or fifteen times the quantity of raw sewage. The aeration period is five hours. Ripened activated sludge equivalent to 25 per cent of the quantity of raw sewage is returned form the sludge reaeration tank to the activation tank. The ratio of diffuser area to tank area is 1:12. Excess sludge from this plant goes to a storage tank, then to the Atsuta plant, from which the sludge of both plants is pumped 4 miles and discharged at the mouth of the Tempaku River outside the harbor.

Atsuta Plant—The site of the Atsuta plant has an area of 2.4 acres, which allows for future extension. The plant is designed for 130,000 population, to handle domestic and factory sewage from an area of 2.07 square miles, including the factory zone of the city. This plant will deal with about 4,700,000 gal. of raw sewage per day in dry weather, and three times the quantity in wet weather. The plant consists of a sewage-storage chamber, a grit chamber, presettling tanks, two aeration tanks, one sludge-reaeration tank, eight final settling tanks and a sludge-storage tank. Existing installations are used for the grit chamber and settling tanks. The aeration tank has the same effective depth as that of the Horidome plant (15.5 ft.) but the channels are 13.2 instead of 7 ft. wide. On account of the greater channel width a deflector wall [baffle?] is provided. This plant is not covered. Sludge disposal is effected as already stated.

Coral Trickling Filters in Singapore

Secondary treatment of the sewage from the city of Singapore, Straits Settlement, is effected by the use of seventeen trickling filters. Nine of these are constructed of the conventional broken stone material, and eight are composed of bits of coral. The engineer's department of the city reports that the performances of the two sets of filters are equally satisfactory.

Brick Manufacturers Discuss Paving Practices at Annual Meeting

Revamping of Old Pavements and Better Methods of New Construction Claim Attention—New Fillers Considered—Lost Time Handicaps Paving Contractors

OF THE fifteen technical papers presented Dec. 4, 5 and 6 before the Chicago convention of the National Paving Brick Manufacturers Association, nearly half related to salvaging old bricks and to relaying and resurfacing procedures. Filler, base and drainage received the usual amount of comment. Tar products were put forward as re-entering the field vigorously as a rival of asphalt, not only for stabilizing foundation material through water exclusion but as a filler material. Regional highway planning claimed attention in two papers. Abstracts of a few of the typical papers follow.

Waste in Construction—Production of pavements consists of two major operations—grading and paving. Both have been thoroughly investigated by stop-watch time studies of the various units by the U. S. Bureau of Public Roads. T. Warren Allen, chief of the division of management of the bureau, indicated in his paper that an increase in production of from 50 to 100 per cent may frequently be secured by excellent management over that possible with poor management, without a corresponding increase in unit costs.

Losses in Power-Shovel Grading

Further data from the studies are as follows: The average contractor doing power-shovel grading is actually excavating, during the time his equipment is on the job, the equivalent of only 42 per cent of the total time available. Of the 58 per cent lost 30 per cent is caused by what may be denominated as major time losses and 28 per cent as minor. The former are made up of definite appreciable stops fifteen minutes or more in duration caused by: rain and wet grade, 10 per cent; shovel and other equipment repair, 10 per cent; moving from cut to cut, 3 per cent; drilling and blasting, 2 per cent; hauling equipment trouble or shortage, 1 per cent; taking on or lack of fuel and water, 1 per cent; miscellaneous, 3 per cent. Minor time losses are the result of: insufficient hauling equipment, 6 per cent; operation of hauling equipment, 5 per cent; moving shovel, 4 per cent; checking grade, 2 per cent; shovel repair, 2 per cent; handling large rocks or stumps, 2 per cent; traffic interference, 1 per cent; blasting boulders, 1 per cent; fuel, 1 per cent; operator, 1 per cent; miscellaneous, 3 per cent. Of the major causes of long periods of lost time 7 per cent are considered avoidable and of the minor causes 16 per cent are considered avoidable, or about two-fifths of the total losses.

Losses in laying concrete are similar to those in grading, 42 per cent being due to major causes and 16 per cent to minor causes. Of the former, rain accounted for 9 per cent; wet grade, 9 per cent; moving plant set-up, 3 per cent; inadequate supply and faulty operation of hauling equipment, 3 per cent; mixer trouble, 2 per cent; lack of materials, 4 per cent; water at mixer, 2 per cent; loading plant, 2 per cent; subgrade, 4 per cent; miscellaneous, 4 per cent. Of these rain, wet grade and moving plant are unavoidable, accounting for one-half of the major time losses. Practically all of the 28 per cent of minor losses can be eliminated by alert management. They are as follows: supply and operation of hauling equipment, 6 per cent; water supply, 2½ per cent; lack of materials, 2½ per cent; mixer trouble, 1 per cent; mixer operator, 1 per cent; finishing, 1 per cent; subgrade delays, 1 per cent; miscellaneous, 1 per cent. In consequence it is fair to say that one-half of the 58 per cent of the total available time lost in concrete work could be eliminated by better management.

BRICK LAYING BY ROLLER CONVEYORS

Improvements in Brick Road Construction Suggested

For brick road construction only a small number of studies have been made, but Mr. Allen stated that in the grading and concrete base operations similar conditions to those noted above were found. The maximum rate at which the brick surface can be laid is not so strictly regulated by a major or key piece of equipment. He suggested the following improvements: Instead of spreading cushion material by hand, it might better be done by truck-pulled spreader boxes used successfully for spreading aggregates and surfacing material on highway. A flexible hose connection between the bitumen-heating kettles and the squeegee apparatus would increase the efficiency of applying the filler.

The roll carrier of bricks to the brick dropper should be improved. Perhaps it should be power operated. For immediate relief it is suggested that it be constructed with two sets of rolls, the set farthest from the dropper to be elevated above the other. The load end should be redesigned to enable the loaders to work without interfering with one another. Increasing the inclination would increase the supply to the dropper. Another improvement would be to elevate both ends and feed from both sides.

Carrier delays are serious. Experiments indicate that on a 19½-ft. single carrier a brick took 14 seconds to travel the length of the carrier when elevated 23 in.; 15 seconds when lowered to 21 in.; 12.4 seconds when

raised to 25 in.; and when increased to 28½ in. 11 seconds, or 20 per cent less time than obtained with the normal height of 23 in.

Different methods used by the droppers gave, according to the jobs studied, quite different results. Droppers stand on the newly laid bricks and face sometimes away from the brick already laid and sometimes toward the curb. Fast droppers facing the curb can lay 3,800 bricks per hour when laying four rows and 4,500 bricks per hour when laying six rows at a time. The dropper facing the direction in which the work is going works with the carrier in front of him out over the cushion. He takes the bricks from the carrier with both hands and carries two rows of bricks across the road. He can lay 5,700 bricks per hour. All of these rates are exclusive of unavoidable delays, such as walking back to start new rows, which takes 3½ per cent of the total time. Other delays plus time for resting are estimated at 10 per cent, making the possible number of bricks which may be laid as 3,400 per hour for four rows, 4,000 for six rows and 5,100 for two rows. Against these figures the studies of the bureau found actual dropping rates as follows: four-row method, 1,716; six-row method, 1,255; two-row method, 1,860 bricks per hour.

With this condition of almost unprecedented waste of the dropper's time prevalent on the average brick pavement construction project, it is evident, said Mr. Allen, that this type is laboring under a severe handicap.

Repairing and Salvaging Old Pavements

Resurfacing Old Pavements—Two papers on resurfacing old pavements with brick and two on salvaging and relaying were the main features of two sessions.

Scott E. McCullough, city engineer, Bloomington, Ill., described replacing an asphalt top, laid in 1899, with brick in 1927. The 6-in. concrete base was found to be in good condition, but depressions of 1 in. or more were removed and a new concrete base was placed. Sand as a cushion rolled with a 2-ton roller evened up lesser unevenness. Bricks 2½x4x8½ in. were laid flat and rolled with a 3- to 5-ton roller and the joints filled with 1 gal. per square yard of asphalt by squeegees operated slowly backward and forward across the pavement until the joints were full. Thereon was spread a thin coat of sand, which was left under traffic for a week and then swept off.

Similar work in Summit County, Ohio, done by Hal G. Sours, county engineer, Akron, differed in method so far as cushion and rolling are concerned. The work was done on 10 miles of old 14-ft. 4-in. grout-filled brick pavement laid on a 4-in. concrete base with 2-in. sand cushion. Six miles was resurfaced with 2½-in. plain wire-cut lug brick, asphalt filled, and 4 miles with 3-in. plain wire-cut brick, all on a 1½-in. granulated slag cushion. A concrete flush curb 12x15 in. was built on each side, at the rate of 2,000 ft. per day. All weak and broken places were cut out and replaced with concrete base. Asphalt binder, varying from 210 to 330 tons per mile, was used to fill depressions in excess of 1½ in. A special crack-filling tar was used after cleaning with an air compressor. Moist granulated slag was rolled with a 5- to 6-ton tandem roller and a templet pulled to cut down the high places and fill the low ones, after which the cushion was rolled and the process repeated with a small amount of fine material. Finally a water roller was used. Where no binder was spread to level up depressions, from 165 to 169 lb. per square yard of slag was used. On the same type of base with binder 114 lb. was used and on one job which was more uniform 88 lb. was used. Where no binder was used a few slight depressions developed under traffic where the depths of cushion were excessive. Other depressions were reported where the slag was dry and difficult to compact. In laying brick a record of 2,680 sq.yd. was established.

On a section 40 ft. wide a 10-ton roller was used effectively without breaking more brick than was broken by the usual lighter rollers. One of the secrets of using the 10-ton roller was to operate it as slowly as possible on the first time over. The slag cushion was another factor. Asphalt filler was applied in two coats from squeegee buggies. The 20-ft. pavement, including repairing, leveling the base course, laying curbs, grading and widening the shoulders, renewing the driveway pipe, providing guard rails, etc., but exclusive of structures, for 3-in. brick, cost $29,500 to $32,500 per mile; for 2½-in. brick, $27,000 per mile.

Papers on Fillers

Fillers—H. W. Skidmore, consulting engineer, in the first of a series of papers on fillers stated that the ideal filler material had not been developed nor had the best methods of using present fillers been devised. Attributes of an ideal filler, in his opinion, are as follows: It must seal the joint against water, support the edges and corners, allow for expansion and contraction, completely fill the joints, act primarily as a filler and not as a seal coat, permit the wearing surface to function as a brick structure and not as a thin concrete slab of inferior quality and finally continue to perform all of these duties without impairment of the brick surface, without unduly increasing the cost of maintenance and without destroying the salvage value of the brick.

Objections to the sand-filled brick construction are that rubber tires suck out the sand, the joint is not waterproof and heavy traffic breaks the unsupported edges. Nevertheless Mr. Skidmore suggested the possibility of developing a penetrated or mixed-in-place mastic or bituminated filler using a cut-back or quick-breaking emulsion. He did not favor the squeegee method of applying filler, but stated that the best examples of brick pavement are those filled with asphalt from the old conical pouring pot. Probably the squeegee has speeded up construction and reduced laying costs, but just how much has been saved in initial cost and how much has been sacrificed of the true value of the pavement with respect to smoothness and non-skid texture, he did not know.

Bituminated Sand as Cushion Material

For cushion material he suggested bituminated sand, say 2½ to 3 per cent of a soft asphalt on tar, cut-back or emulsion, to give sufficient coating and cohesiveness without interfering with workability when handled cold. This material will compress slightly under a light roller and will produce a bed of real cushioning ability and will stubbornly resist displacement.

For squeegee application he commended the specification used by the Ohio State Highway Department and tentatively accepted by the American Association of State Highway Officials, but he warned of the danger of its losing its asphaltic characteristics by overheating.

Sand cannot be used as a filler or cushion on steep streets, said Mr. Savage, city engineer, McKeesport, Pa. Neither can it be used as a blotter over a squeegeed surface. The sand washes down and must be removed from the catchbasins. Grout and asphalt filler only can be used, the former preferred. At intervals a header

board is laid to prevent water following down the slope under the brick with obvious consequences.

H. C. McClure, city engineer, Flint, Mich., spoke of using a heater pot on top of a squeegee box by which filler material is kept up to designated temperature, thereby getting filler to the bottom of the joints in the first application.

William H. Connell, executive director, Tri-State Regional Planning Federation, said that a long course of investigation of brick pavements all over the country showed that joints of asphalt well filled to the bottom give the best results. Sand was obsolete, in his opinion. Grouted joints held up the edges, but the other defects more than offset this advantage.

Earl H. Newell, of Lewis & Copeland, contractors, described methods and results obtained with asphalt filler applied by hand and by a squeegee box on the William Penn highway in western Pennsylvania. About 15 per cent of the joints filled by the box showed an unprotected top edge for $\frac{1}{16}$ to $\frac{1}{8}$ in., but all joints were filled at the bottom. Hand pouring with 2-qt. coffee pots with the strainers cut out was found to be the best method. Each pourer was allotted a ten-course section and he was instructed to return after 30 minutes and patch any places left low. The surface was then sanded. The average day's pouring required 100 pots of asphalt, or six minutes to each one. About 5 per cent of the hand-poured joints were not perfectly filled. These were considered more serious however, than the 15 per cent of squeegee joints slightly below level. Both methods give good results in summer weather. The hand-poured job required $9\frac{1}{3}$ lb. per square yard, while the squeegee method required $8\frac{2}{3}$ lb. Bricks were 3 in. deep with $3\frac{1}{4}$ x $8\frac{1}{2}$-in. tops.

Asphalt and Grout-Filled Sections Compared

P. M. Tebbs, assistant chief engineer, Pennsylvania Department of Highways, in his complete description of the above-mentioned highway contract, compared the asphalt and grout-filled sections. Less spalling is taking place in the grout-filled section, but he feels that the squeegee method will give the better results in the long run. The 1:4 cement-sand bed mixture used is richer than necessary and probably was the cause of excess breaking of brick under the 5-ton roller which was supplanted by a 3-ton roller.

Regional Highway Planning—Two addresses on regional highway planning included a general description of the problem by J. G. McKay, Cleveland Highway Research Bureau, and a detailed statement of the regional highway planning in Allegheny County, Pa., by E. L. Schmidt, chief engineer, bureau of roads, County Department of Public Works. The latter consists of 450 miles of radiating highway to serve Pittsburgh as a hub and two encircling highways, inner and outer belts, to bypass the congested business district. About 70 per cent of the outer belt of 90 miles and the whole 60 miles of the inner belt are completed. Work on three major river boulevards is now being prosecuted: Saw Mill River Boulevard, 3 miles long, costing $1,000,000; Allegheny River Boulevard, $4\frac{1}{2}$ miles, to have no highway grade crossings, costing $3,500,000, and the Ohio River Boulevard, 5 miles long, 40-ft. brick pavement, 80 per cent under construction, involving seven major and three minor bridges.

Mr. McKay sounded a note of caution against planning excessively wide pavements outside of certain limited areas. Usually 30 miles as a maximum will be found sufficient distance out to carry even four-lane roads. The range of travel of 75 per cent of the passenger cars is 60 miles, and of 65 per cent it is only 20 miles. For most of the cities of the country 10 miles out is the limit of congestion. The reason so many plans fail, in his opinion, is because they are not based on knowledge of traffic requirements. Traffic should not be concentrated at one end of a wide highway and dumped at another end; therefore it is often better to seek new arteries rather than make excessively wide ones.

Railway Developments in India

GREAT activities in the extension and improvement of railways in India during the past few years and still in prospect are outlined in a special number of the *Railway Gazette*, of London. With a system of 41,000 miles, up to March, 1929, nearly 30,000 miles are owned by the government of India and about 18,000 miles of these lines are operated directly through the Railway Board, while 12,000 are operated by companies under long-term contracts with the government. The remaining 11,000 miles are owned and operated either by private companies or by the governments of native states. The paper mentioned doubts the advisability of direct government management, but suggests operation by a company formed by the government, as in the case of Canada, Belgium and Germany. In actual management, the earlier departmental system is being changed gradually to the divisional system, with its greater flexibility.

About 50 per cent of the mileage has the broad or Indian standard gage of 5 ft. 6 in., while 40 per cent is on the meter gage, the remainder consisting of lines having gages of 30 in. and less. Of several long through routes, there are two of 1,349 and 1,223 miles between the east and west coast ports of Calcutta and Bombay. From Madras, in southern India, there are routes of 1,032 miles to Calcutta, 792 to Bombay, 459 miles to the most southern point and 2,154 miles to Peshawar on the northwestern frontier. Fast long-distance trains average 40 miles an hour or more, but ordinarily even the fast trains do not exceed an average of 30 miles an hour, owing to the long stops at stations. Notable mountain lines include the Khyber main-line extension of the Northwestern Railway, with grades of 3 per cent, and the three short lines of the Kalka-Simla Railway, the Darjeeling-Himalaya Railway, with grades of 4 per cent, and the Nilgiri Railway, which is a rack-rail line.

Improvement works consist largely of double tracking, heavier track construction, grade reduction, bridge reconstruction for heavier loading, new passenger and freight terminals, repair shops and block signaling. At Bombay, electrification has been completed for several miles on the two trunk lines entering the city, while electrification at both Calcutta and Madras is being studied on account of the traffic congestion and growing suburban business. New equipment is being purchased in large quantities owing to the increase in traffic and trainloads. This includes powerful locomotives, passenger cars of the most modern types and large freight cars (up to 40 tons capacity).

It may be noted that the bulk of imported equipment and material is purchased in England, as is natural, but India is increasing its production of rails, steel ties and other material. There has been some complaint to the English government as to the placing of contracts from India with low bidders in other European countries, but in answering such complaints it is pointed out that the government of India is now practically an independent power so far as domestic affairs are concerned.

Letters to the Editor

Faulty Street Operation

Sir—Apropos of your short editorial in the issue of Nov. 7 under the caption "Faulty Street Operation," a crying illustration of this is First Ave. in the Borough of Manhattan.

Portions of this 60-ft. roadway are used as a street market with pushcarts. Delivery of material to the pushcarts and to the stores in front of them occupies the entire space between the curb and the elevated columns. The result is room for two moving lines of traffic in a 60-ft. roadway recently paved up to form one of the main thoroughfares of the city. ENGINEER.

New York City, Nov. 27, 1929.

Awarding Contracts to Local Bidders

Sir—I wish to indicate my approval of your editorial in the Nov. 28 issue of *Engineering News-Record* in which you refer to breaking faith with contractors when awards are made to local bidders when accredited bidders from a distance have submitted lower bids. I have seen that happen more than once, and every time I have considered it a distinct breaking of faith and poor sportsmanship. I have known of instances where contractors have gone to great expense in making up their tenders and have won the contract by all the rules of the game and still have been turned down because of the desire to favor a local bidder. It is unfair from every viewpoint and I am glad to see your good paper with such an editorial discouraging it. L. R. ASH,

Ash-Howard-Needles & Tammen,
Kansas City, Mo. Consulting Engineers.
Dec. 2, 1929.

Unofficial Statements by Officers of American Engineering Council

Sir—In the editorial pages of your issue of Nov. 14 you draw from a press report an inference of misuse by one of its vice-presidents of his connection with American Engineering Council. The occasion is an article by the gentleman in question and your thought that notice beyond what it would normally have had was acquired for it by use of his position in Council.

Although the clipping services which Council employs have not unearthed the press report in question, there appears no doubt that it refers to a recent article by Major Gardner S. Williams, and it is for this reason I am addressing you.

I have known Major Williams practically throughout his contact with Council. I can testify, as can, I believe, every other member, to the exceedingly high plane of his personal standards. He is meticulous in his differentiation of his personal opinions from those of Council, and if your thought has been that he suggested, or even permitted, the connection which you find objectionable, I hope you will accept my assurance that this would be impossible.

Major Williams has been long known and his association highly valued in American Engineering Council, and it may well be that the reporter had this knowledge and himself coupled the statement with his comment on the article.

I sincerely hope that you will find it possible to do Major Williams the justice of including this communication prominently in your next issue. A. W. BERRESFORD,

Washington, D.C., President,
Nov. 25, 1929. American Engineering Council.

The editorial in question did have reference to statements made by Gardner F. Williams in a press dispatch from New York to the Boston *Transcript*. *Engineering News-Record* would be the last to imply that Major Williams' personal standards are not of the highest character and the editorial in our issue of Nov. 14 was in no way intended to reflect upon them. Its purpose was to emphasize what should be re-emphasized here—namely, that the responsibility of officers of American Engineering Council is so great that when they express their personal views they have not fulfilled their obligations to the engineers whom they represent until they are absolutely sure that all who hear their views expressed know that the views are personal ones and not those of Engineering Council. We believe they should even go further than this. While serving as officers of Engineering Council it would be well if they were to refrain from expressing their personal views on engineering matters in public. In any event they should at least refrain from such a blanket attack upon a whole group of members of the engineering profession as was Mr. Williams' attack upon the Corps of Engineers.—EDITOR.

European Lumbering Methods

Sir—It is somewhat surprising to find in your Oct. 17 issue that such a letter as that signed by "A. Lumberman" should have got past the editorial scrutiny and been included among the correspondence presumably adapted to serious consideration of matters of interest to engineers.

Doubtless before this letter reaches you from this somewhat distant region you will have received sufficient corrective information on French lumbering methods from some of those who served in the Forestry Section in France during the War, so it would be superfluous to take exception in detail to the report made by the man who served in the "Forestry Corps of the United States Army."

To one who served in command of a lumbering operation in that year his description of the methods employed by the Americans in France seems more suitable for your humorous column than for serious consideration. Your correspondent forgets that the war was going on when this lumbering was being done and that those he refers to as "natives" had their part in it as well as ourselves and had little time to stand around in silence to admire the advanced methods of the Americans.

As a final humorous touch he reaches the climax in his description of the soldier on leave from his own forestry work who spent two entire days watching the inadequate methods employed on lumbering by the natives. I have heard of postmen who devote vacations to walking trips but never of a soldier on his "leave" time inspecting the operations of other armies. It is unfortunate that this young man did not obtain an extension to his leave of absence.

I should recommend that your correspondent devote a little more time to studying the proper sections of the reports of the Chief of Engineers of the A.E.F., in particular that of the head of the Forestry Section, if he wishes to obtain some information as to how lumbering was carried on in France during the war. HENRY WELLES DURHAM.

Managua, Nicaragua,
Nov. 14, 1929.

Pump Discharge Headers and Piping

Sir—I submit the following comments on the abstract of a paper by F. G. Cunningham in your issue of July 4, 1929, p. 24. To the comments I append a scheme for replacing the usual pump header by a water tank.

It was not stated in the text of the article nor shown on the diagrams whether every force main is provided with either a check or a gate valve. It only said: "Check valves on the discharge side of centrifugal pumps are practically essential in all ordinary cases," and no reference is made to other kinds of pumps. Supposing that in Fig. 11 the pumps are turbine pumps, the diagram shows just what is aimed for it by the writer and the individual valves are in the right place. But to Fig. 11 there is a remark: "It is unnec-

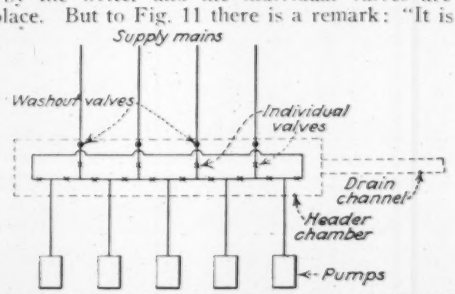


FIG. 1—HEADER WITH INDIVIDUAL VALVES

essary to provide valves in the individual discharge pipes of the various pumps, because any pump can be isolated by closing the header valves lying on either side of the tee for the pump connection."

None of the diagrams shows a good or complete header system because of lack of either check or gate valves in the supply mains just at the header tee pieces where the supply mains begin. Why? It must be considered: (*a*) The force mains are under a pressure ranging from maximum to zero, the latter when their content is drained off. (*b*) Without having closed the force mains by individual valves or non-return valves the water contained in the force mains will enter the header chamber if there is any defect in the header such as a broken valve. In most cases where the force mains are divided by section valves the first section has to be drained to the header chamber and the quantity of water is a considerable one.

In most cases the pumping station is at a lower level than the force mains, or at least lower than a great part of their length, and therefore it is essential to provide an outward (?) valve on each supply main; moreover, every valve should be provided with a spare [duplicate] valve.

From the preceding remarks I think it is obvious that individual valves or non-return (?) valves on the supply mains are essential whether turbine or other kinds of pumps are used. My conception of a completely valved header system is shown by Fig. 1.

Turning now from Mr. Cunningham's paper, I submit a scheme for replacing the usual header and pipe connections at a pumping station with a small elevated tank if there is no elevated water reservoir near to the pump station. From a good header scheme it is wanted:

1. The pump need be closed down only when it is out of order; no other part of the system shall be affected.

2. All the supply pipes shall be fed at any time by any pump and shut down thus only when the supply main is out of order.

3. The number of valves shall be reduced to a minimum without affecting any other part of the system.

4. All valves shall be accessible and easily repaired or replaced in a moment.

5. Any valve shall be examinable at any time without affecting any part of the system.

6. The operation of the valves shall be simple and no danger involved to the pump so that use of relief valves can be avoided.

7. Any part of the whole system shall be accessible for inspection and repair.

All those features are aimed at by the elevated tank shown herewith. If the tank should get out of order, the whole supply would be cut off. But that will not happen. It should be built of reinforced concrete. As quick-setting cement of good quality is available, any outside repairs can be made in a few minutes by any engineer of normal sense, with a few and simple tools. Inside repairs of the bottom can be made by means of open caissons sunk in the tank. Repair of valve seatings can be done in the same way, but that is hard to imagine.

Double valves are provided; if one needs repair, the other is put in use. They are open pipes with suitable seatings on the bottom. A rubber ball can be used for a valve. Spare connections on the bottom of the tank shall be provided.

PALOTAI ARMIN,
Assistant Engineer,
Jerusalem Water-Works.

Jerusalem, Palestine,
Sept. 15, 1929.

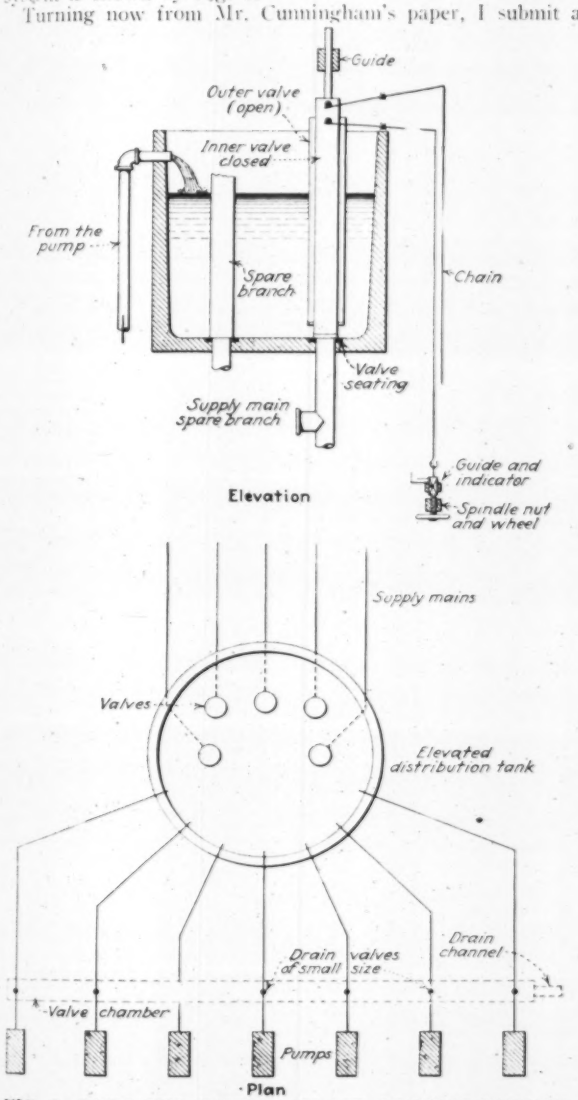


FIG. 2—ELEVATED TANK IN PLACE OF PUMP HEADER

* * *

Mr. Cunningham submits the following comments on Mr. Armin's communication.—EDITOR.

Sir—Regarding the use of check valves in individual pump discharge pipes, it is my belief that these should be used wherever the pumps are of the centrifugal type, as stated in my paper. Where pumps are of the reciprocating type, the pump valves in themselves constitute adequate check valves. Such valves are not shown in the diagrams accompanying the paper, as they do not relate to the essential features under discussion.

The use of check valves in the outgoing supply mains immediately beyond the header, which use I understand Mr. Armin to suggest, is novel and does not seem particularly advantageous. In the event of a break in the header system it is evident that water will issue from the break as long as any of the pumps are running and until the break is isolated by closing valves, regardless of whether or not there be check valves in the supply mains. Whether gate valves should be provided in the supply mains beyond the header depends upon local conditions. At any rate the writer had not intended to discuss what should be provided in such lines after leaving the header.

Mr. Armin's suggested use of an elevated tank to replace a header system is novel. If the individual pump discharge pipes were carried upward to a level above the highest hydraulic gradient and there spill the water into the elevated tank, such a device would accomplish a part of the purpose of the header system in that it would offer a means of separating the discharge pipes from each other and from the supply mains. It would not, however, separate the supply mains from each other without the use of some expedient of doubtful workability such as Mr. Armin suggests. Also the repair or alteration of the elevated tank without putting the system out of service would be difficult if not impracticable. Other objections to this arrangement would relate to appearance and cost, particularly with very large pipes, high pressures, or both. Also the arrangement leaves no opportunity for varying the pump pressure.

F. G. CUNNINGHAM.
New York,
Nov. 1, 1929.

News of the Week

San Gabriel Contract Cancelled

Following condemnation of the Forks site on the San Gabriel River by Edward Hyatt, California state engineer, as unsafe for the construction of the high dam proposed by the Los Angeles County Flood-Control District, the Los Angeles County Board of Supervisors has voted to rescind the $11,250,000 construction contract with Fisher, Ross, McDonald & Kahn. At present negotiations are under way between legal counsel of the flood-control district and the county and legal representatives of the contractors in an effort to effect a compromise. In the event of failure, it is expected that the contractors will sue for an accounting.

New Dry Dock Opened

A new graving dock which has been under construction in the Erie Basin, Brooklyn, N. Y., for the past year and a half was opened on Dec. 7. It is the largest private graving dock on the Atlantic seaboard, being 731 ft. long and capable of taking vessels of 29 ft. draft. The dock is constructed of concrete except for a portion of the floor and the gate. The gate is of steel of the floating type. Both an outer and an inner gate seat is provided so that the position the dock requiring to be unwatered may be reduced when small vessels are under repair. Two large electrically driven pumps are provided for unwatering the dock. Their capacity is such that the full dock can be emptied in less than two hours. The dock was built by the Todd Shipyards Corp. with its own forces under the direction of Frederic R. Harris, rear-admiral, U. S. N., retired, as managing engineer.

Denver Takes Over Moffat Pioneer Tunnel

On Nov. 29 the city of Denver made the first payment on its contract for use of the pioneer bore of the Moffat tunnel. The payment consisted of $20,616.25 to the Moffat Tunnel Commission for maintenance of the bore from Jan. 1, 1929, until Sept. 1, when the Denver Water Commission took charge. Another warrant for $65,000 was issued in favor of the Denver Machine & Supply Company to cover certain machinery which had been left at the west portal after the completion of the tunnel. This machinery, which includes several electric locomotives, electric cable, dump cars and other equipment, will be used in the maintenance work, mainly that of lining the bore with concrete, and the transportation of material.

Under the terms of the contract, by which the city took a lease of the pioneer bore for a term of five years at $1 a year and assumed responsibility for its maintenance, the work of lining the tunnel must begin not later than September, 1933, and must be completed by September, 1936. The city expects to spend not to exceed $50,000 annually upon maintenance and eventually to expend a sum, variously estimated at from $10,000,000 to $30,000,000, for a system of reservoirs and canals to bring water into Denver from the western slope of the mountains. Announcement of the leasing of the pioneer bore by the city was published in *Engineering News-Record*, Nov. 22, 1928, p. 786.

Hoover Conference Acts to Maintain Business

Committee Formed to Carry Into Effect Programs Outlined at Washington—Construction Activity Forecast

SYSTEMATICALLY spreading into industry as a whole the measures which have been taken by some of our leading industries to counteract the effect of the recent panic in the stock market, as President Hoover phrased it, was the object of last Thursday's conference of industry in Washington. The purpose of the conference was to organize construction and maintenance work to take up any slack in employment which might arise in other activities. The President called attention to the fact that business men and economists are agreed that the acceleration of these activities in time of need makes "a great balance wheel of stability." He made the statement without qualification that "temporary speeding up to absorb idle labor brings great subsequent benefits and no liabilities." He emphasized the fact that nearly one-fourth of American wage earners are employed directly and indirectly in construction and in the industries engaged in the preparation and transportation of its raw materials.

"There are at the moment," Secretary Lamont said in his talk to the conference, "more equipment orders on hand and in prospect than at any time in the past several years. The important thing is to keep up employment in wages, which spell buying power. We have learned that, when necessary, it is better to reduce hours than wage rates. If worse comes to worst it is advisable to alternate men by the week, giving some income to as many as possible."

Julius H. Barnes, chairman of the board of the U. S. Chamber of Commerce, called attention to the fact that modernization offered a most profitable field even in those communities where residential and apartment building have reached an apparent saturation point.

The work of translating into actual accomplishments the pledges made at the conference will be carried out by two temporary committees, the first a "larger conference committee based on trade association representation," which will organize each industry for expansion and maintenance work; the second a smaller working committee made up of individuals "selected for their individual attainments and their wide knowledge of business affairs."

Speakers before the conference representing 32 widely divergent trade groups presented plans for their respective fields for the coming year. In the field of construction materials, it was brought out that the greatest activity during the approaching year is to be expected in roadbuilding. Several speakers representing the various state highway departments informed the conference that the building of roads is constantly lagging behind the demand despite the high construction level maintained during recent years. It was agreed by those speaking on the subject that the withdrawal of money from speculation on the stock market will be of material benefit in securing the necessary financing for highway construction.

Industries Reveal Plans

James A. Farrell, president of the United States Steel Corporation, stated that there would be no changes in either wages or prices. If some people in the industry think that they can pinch off a few cents here and there they will find, he said, that there are other people who will see that they don't. Now is the time, stated Mr. Farrell, for the steel industry to modernize existing plants and make repairs. Authorized expenditures for this purpose total $500,000,000, he said.

Frank H. Smith, president of the Portland Cement Association, stated that shipments of cement in 1929 will run about 3 per cent less than in 1928 and that prior to the recent Hoover conferences it was expected that shipments in 1930 would be anywhere from 5 to 10 per cent less than during the current year. Since then, he said, the industry has gained more confidence and now expects that as a result of large appropriations for roadbuilding and public works and increased construction and maintenance work planned in industry the expected slump will be forestalled.

The life insurance companies and other insurance organizations will have about $800,000,000 to invest in construction enterprises during the coming months of the new year, it was stated

by Frederick H. Ecker, president of the Metropolitan Life Insurance Company. John G. Lonsdale, president of the American Bankers Association, said that ample bank credit is available for financing industry and trade, but he added a word of caution against arousing too much expectation of cheap money. Trowbridge Calloway, president of the Investment Bankers Association, expressed the opinion that moderate and stable interest rates would aid in the distribution of securities, but he voiced a warning against stimulating the issuance of new securities. An increased demand for building mortgage securities was reported by Hiram S. Cody, representing the Mortgage Bankers Association.

Railways Maintain Expenditures

Declaring that the railroads do not believe that there is anything in the existing situation that would warrant them to reduce or abandon any part of their capital program, R. H. Aishton, chairman of the executive committee of the Association of Railway Executives, informed the conference that their 1930 program calls for an expenditure of $1,050,000,000, of which $370,000,000 has been budgeted for equipment and $680,000,000 for roadway and structures.

The 1930 program of the public utilities, presented to the conference by Matthew S. Sloan, president of the National Electric Light Association, calls for the expenditure of $1,400,000,000 for new construction, an increase of $110,000,000 over 1929, and $410,000,000 for maintenance. The public utilities are healthy, said Mr. Sloan. Their business has grown normally this year and he expressed the opinion that there is no apparent reason why it should not continue to grow next year.

J. N. Shannahan, of the American Electric Railway Association, revealed that the association has just completed a canvass of the local transportation industry of the United States to determine what effect if any the recent recession in security prices would have upon construction and maintenance expenditures planned for 1930. Of the executives replying to the inquiry, 97 per cent do not anticipate any change in business conditions that would affect expenditures for these purposes. This industry comprises 637 companies operating street car, rapid transit, interurban and bus lines in all sections of the country. It carries annually approximately 16 billion passengers. Preliminary figures indicate that this industry expects to spend in 1930 more than $149,000,000 for new construction, chargeable to capital. This is an increase of approximately $43,000,000 over corresponding expenditures for 1929. In addition it will spend approximately $240,000,000 for renewals and maintenance of existing facilities, which is slightly over the corresponding figure for 1929. This makes a total of $389,000,000 in 1930 for the purchase of materials and employment of labor in construction and maintenance.

President Outlines Government Needs in Annual Message

Advises More Money for Buildings, Flood Control and Waterways—Federal Finances in Excellent Condition

FEDERAL government expenditures affecting public works and engineering construction form a prominent part of the message transmitted by President Hoover to Congress at the opening of the regular session Dec. 4. The general financial condition of the federal government was held to be sound, with the public debt at its lowest figure since 1919, having been reduced $238,000,000 in the past fiscal year. A surplus of about $225,000,000 is predicted for the close of the fiscal year 1930. Total appropriations recommended for 1931 are $3,830,445,231.

Further provision for public buildings, both in the District of Columbia and in the country at large, is urged by the President, despite the fact that Congress has already authorized considerable expenditures for this purpose. The President holds, however, that an increase in the program is justified by the present need for additional space. He also recommends that private buildings proposed for sites facing upon public buildings and parks in the District of Columbia should be placed under the jurisdiction of the Fine Arts Commission to aid in beautifying the capital.

River and Harbor Work

Completion of the Ohio River project should release approximately $4,000,000 per year for other river and harbor work. In addition to this amount, Mr. Hoover recommends an increase in the appropriation for rivers and harbors from $50,000,000 to $55,000,000 annually. For Mississippi flood-control work, the President recommends an increase in appropriations from $30,000,000 for the present year to $35,000,000 during the next fiscal year. He also approves expansion of the intracoastal waterways system. No recommendation is made for the St. Lawrence project, as this awaits the action of Canada.

While the President does not see fit to recommend increasing the amount of federal aid for highway work at the present time, he recognizes the fact that road construction must be a long-continued program, and that ultimately it will be necessary to give consideration to increasing federal contributions to the system. The message states that of approximately 3,000,000 miles of legally established highways in the United States, about 10 per cent are

PUTTING A RIVER UNDER GROUND IN ST. LOUIS

Wide World Photo

Work of confining the River Des Peres for 13 miles through the city of St. Louis, Mo., was started in 1924 and is still going forward. This picture, taken in Forest Park, shows concrete being poured into the forms from the top of a traveler. It is brought in trucks from a central mixing plant. The sewer is of horseshoe section 32 ft. wide and 29 ft. high in the clear, and will carry about 10,000 sec.-ft. The depth of cut at the point shown is about 40 ft. The W. E. Callahan Construction Company has the contract for this section, about a mile in length, which will cost about $850,000. The work is being done for the Department of the President, city of St. Louis, under the supervision of W. W. Horner, chief engineer of sewers and pavings, with W. R. Denison as resident engineer. The entire project will involve an expenditure of about $11,000,000.

included in state highway systems, the remainder being county and local roads. About 626,000 miles, comprising about 63 per cent of the state highway systems and 16 per cent of the local roads, have been surfaced; of these about 102,000 miles are hard surfaced. This comprises about 22 per cent of the state highway systems and about 8 per cent of the local roads.

Proposed legislation in the railway field necessitates no immediate expenditures by the government. It is recommended, however, that Congress simplify and expedite consolidation methods in order to secure well-balanced systems with uniform and satisfactory rate structures and greater efficiency. It is also recommended that members of the Interstate Commerce Commission be relieved of necessity of giving detailed personal attention to minor matters by delegating such routine work to subordinate officials.

In the section of the message devoted to conservation the President briefly reviews the necessity for saving oil and gas resources and of preventing the destruction of ranges by overgrazing. The necessity for extensive storage of water in the arid states, together with the fact that most available lands of the public domain suitable for reclamation have already been included in existing or planned projects, renders it desirable, in his opinion, to reconsider the national reclamation policy. The President has already appointed a commission to study these problems, and recommends that Congress provide a moderate sum of money to defray the expenses of the necessary investigation.

Boston Vehicular Tunnel Approved

Permission has been formally granted by the War Department for the construction of a vehicular tunnel to connect Boston and East Boston, Mass., under the waters of the harbor. Immediate construction is not expected, because of the fact that plans for the tunnel approaches have not yet been definitely settled upon.

Two Railroads to Extend Lines in New Mexico

Permission has been granted by the Interstate Commerce Commission to subsidiaries of the Texas & Pacific and the Atchison, Topeka & Santa Fe railroads to extend present branch lines to Lovington, N. M. One branch will be built by the Texas-New Mexico Railway, a subsidiary of the Texas & Pacific, from its existing line at the Texas-New Mexico boundary to Lovington, a distance of 70 miles, at an estimated cost of $1,825,000. The second line, to be constructed by the South Plains & Santa Fe Railway, a subsidiary of the Atchison, Topeka & Santa Fe, will extend 46 miles from Seagraves, Tex., to Lovington, at an estimated cost of $2,711,850. The application of the South Plains & Santa Fe Railway for permission to build 43.5 miles of new line from Lovington southerly to the Texas-New Mexico boundary was denied, as this would conflict with the new branch of the Texas & Pacific.

Daniel A. Garber Dead

Daniel A. Garber, general manager of the Associated General Contractors, died in Washington, Dec. 4, from post-operative pneumonia. He was 69 years old. After serving an apprenticeship in the building trades, Mr. Garber engaged in the contracting business in 1889, and in 1904 became president of the North Eastern Construction Company, of New York, Baltimore and Winston-Salem, N. C. He was the first president of the A.G.C., serving in that office in 1918-19. He resigned from his company May 4, 1928, to become general manager of the association. Chief among the programs inaugurated by Mr. Garber for the advancement of the construction industry were the establishment of credit bureaus to eliminate loose credit conditions, the prequalification of contractors on public works, the development of better methods of writing surety bonds and the establishment of a sound merchandising structure within the industry.

Underwood & Underwood

DANIEL A. GARBER

Among the projects to the credit of Mr. Garber in New York City were the Administration, Hospital and Entrance buildings on Ellis Island, built in 1907; the alteration of Brooklyn bridge to provide for the connection between the elevated and subway next to the Pulitzer Building, in 1911; the Chelsea piers between 14th and 23d Sts.; the original group of buildings for the College of the City of New York, completed in 1903 and 1904, and construction of the Brooklyn approach to the Manhattan bridge.

Among his more recent projects was the first unit in Baltimore's $50,000,000 port development program, the McComas Street Terminal.

Los Angeles Loses Fare Suit

Collection of a 7c. fare by the Los Angeles street railway system, despite franchise provision for a 5c. limit, was upheld by the U. S. Supreme Court in a decision handed down Dec. 2. The suit was brought by the California Railroad Commission and the city of Los Angeles in an attempt to force conformance with the franchise provision. The Federal Court for the Southern District of California found that the 5c. fare would be confiscatory, and this opinion was upheld by the Supreme Court. The transportation company contended that the state had never authorized the city to make binding franchises and that, if the power to do so had ever existed, it had been abrogated by the establishment of the State Utility Commission to supervise all street railways.

Brief News

SUBWAY CONTRACTS in Brooklyn and Queens, New York City, totaling more than $13,000,000, have been awarded by the Board of Estimate and Apportionment.

FURTHER CONSTRUCTION on the Hetch Hetchy project of the San Francisco water supply has been made possible by the purchase of a $4,000,000 lot of municipal bonds by the Bank of Italy.

EXTENSION OF THE SEWERAGE SYSTEM of Spartanburg, S. C., is assured by a decision of the South Carolina Supreme Court upholding the legislative acts creating a metropolitan sewer district and authorizing the issuance of $1,000,000 in bonds.

NATURAL GAS for St. Louis industrial uses is now being delivered through the recently completed 431-mile pipe line from the Monroe and Richland fields of Louisiana. Work on the 22-in. line, which cost approximately $30,000,000, was started in April.

WORK OF REPLACEMENT of the Mountain Creek service bridge of the Texas & Pacific Railway 9 miles west of Dallas, which was destroyed by fire Nov. 30, is progressing rapidly. The cause of the fire, which did $40,000 damage, has not been ascertained.

ACQUISITION OF THE WATER-WORKS of Waterloo, N. Y., was approved by a popular vote of 396 to 8, states C. E. Andrews, mayor. The village trustees will receive bids on Dec. 26 for $160,000 of bonds. It is expected that the works will be taken over from the New York Service Water Corporation on Feb. 1, 1930.

ADVANCED INSTRUCTION IN SURVEYING will be taught at a new camp in Jackson's Hole, Wyo., under the supervision of the University of Michigan. The camp, which occupies 120 acres, has been named Camp Davis in honor of Prof. J. B. Davis, who, in 1874, organized the first summer camp for field work in surveying.

Researches in City Planning Started at Harvard

Three research projects, one as to the height of buildings, a second on the density of residential distribution and a third as to the legal aspects of municipal airports, have just been undertaken by the new Harvard School of City Planning. George B. Ford, past-president of the American City Planning Institute, will undertake the investigation of the subject, "What Zoning Has Done to Limit the Height and Bulk of Buildings, Especially in Commercial and Apartment Districts, and What Further Limits Should Be Placed on Building Height and Form." Robert Whitten, president of the American City Planning Institute, will investigate the question of "Optimum Densities for Residential Distribution Under Zoning and Platting." Frank B. Williams, author of "The Law of City Planning and Zoning," will investigate the subject of "The Legal Aspects of Municipal Airports." Mr. Williams is a member of the board of directors of the National Conference on City Planning and a member of the board of governors of the American City Planning Institute.

In the latter study Mr. Williams is co-operating with Dr. Miller McClintock and Prof. Henry V. Hubbard, who are together undertaking a research financed by the Milton Fund of Harvard University. Dr. McClintock is considering the problems of the airport as relating to municipal government and Professor Hubbard is considering the airport as a unit in the city plan.

To Survey Prospective Traffic for San Francisco Bay Bridge

The San Francisco board of supervisors has appropriated $40,000 for traffic surveys and foundation borings in connection with preliminary studies for the proposed bridge across San Francisco Bay to connect San Francisco and Alameda counties. Request for this information has been made by the San Francisco Bay Bridge Commission appointed jointly by President Hoover and Governor Young of California.

The traffic survey will be divided. On Dec. 12 a survey will be made of the passenger traffic and an effort made to secure from each passenger traveling across the bay from San Francisco to the East Bay district a statement of the points in San Francisco and the East Bay section between which he is traveling and whether the trip is a regular or an occasional one. On Dec. 17 similar information will be sought on automobile traffic. The survey of passenger traffic will include transbay passenger service on the Key Route and Southern Pacific ferry systems, and the survey of automobile traffic will include the automobile ferry service of the Southern Pacific-Golden Gate Ferries, Ltd., from San Francisco to Richmond, Berkeley, Oakland and Alameda.

Past surveys have shown that approximately 60,000 persons cross San Francisco Bay on the passenger ferries each week day from the East Bay district to San Francisco and that 12,000 automobiles use the automobile ferries daily.

C. H. Purcell, state highway engineer, who is also secretary and a member of the joint commission, is in charge of all investigation work to be carried on in behalf of that body. Lester S. Ready, consulting engineer for the State Department of Public Works, is in charge of the traffic survey.

The Business Outlook

The latest week's records show continued business recession. Industrial activity is running about according to schedule, but is showing considerable strength. General trade activity seems to be falling off somewhat more rapidly. The credit system and security market outlook are not so favorable. Easing of money for business expansion is retarded by a rather heavy burden of commercial and security loans being carried by member banks.

An encouraging feature of the week's records is the sharp rise in the daily average of general building contracts awarded, which brings them not far below last year's level at this time.

—The Business Week, Dec. 11.

Missouri to Buy Large Quantity of Cement

Bids for 2,000,000 bbl. of portland cement for use in road construction during the coming year are to be received by the Missouri State Highway Department, Jefferson City, on Dec. 19.

German Engineer Honored by Museum Directors

Oskar von Miller, director of the Deutsches Museum in Munich, Germany, was the guest of honor at a dinner in New York on Dec. 5 given by the officers and trustees of the Museums of the Peaceful Arts. Dr. von Miller, who is on his way back to Germany from the World Engineering Congress in Japan, stopped at Chicago, Philadelphia and New York in order to consult with the directors of the industrial museums now being developed in each of the three cities. Work on the Deutsches Museum was begun by Dr. von Miller in 1903. It now is the most outstanding industrial museum in the world and the pattern for similar undertakings in this country.

At the close of the dinner in New York Frederic Pratt, president of the Museums of the Peaceful Arts of New York, announced that the directors had found it possible to take a whole floor of a large new office building in order to display the material already acquired.

Second Hoisting Accident in Chicago

Another building construction accident occurred in Chicago on Dec. 4, when a derrick failed while hoisting a load of steel at the National Parking Garage, on Quincy St., but as the load was not far from the ground no injuries resulted. The steel mast of the guyed derrick fell across the floor framing and bent at right angles, the part extending over the street lying flat against the front of the building. As the street is only a block in length and has not much traffic, about half its width in front of the building is occupied largely by construction material. This is the second recent hoisting accident on Chicago buildings, in the first of which a pedestrian was killed. As a result, the building commissioner has called a conference of architects and contractors to determine some method of preventing such accidents.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

I.C.C. Troubled by Railroad Holding Companies—Federal Power Commission Relief Plans

CANDIDLY admitting that its attempt to maintain control over railroad consolidation is likely to be defeated by establishment of common controls through the medium of holding companies acting in concert with the individuals creating them, the Interstate Commerce Commission has referred the problem to Congress for thorough investigation, with no suggestion for remedying this "evident danger" to the maintenance of competition. Such an investigation, the commission said, may disclose the answer to the difficult legal, and perhaps constitutional, questions involved. Senator Couzens, chairman of the Senate interstate commerce committee, has been advised by counsel that the commission undoubtedly has jurisdiction over holding companies but that new legislation would serve to fortify the commission's position. The commission admitted the possibility that the Clayton anti-trust act may enable it to control the situation, but expressed the belief that this would be accomplished only after protracted litigation.

Railway Consolidation

As for accomplishing unification of the railroads by what the Interstate Commerce Commission calls "the orderly processes of a carefully planned scheme of public regulation," President Hoover in his message to Congress advocates legislation to simplify and expedite consolidation methods presumably along the lines proposed in the pending Parker bill. This would obviate the necessity for waiting upon final valuation of the railroad properties involved in merger proposals and would

also permit creation of the corporate machinery required to effect the objects sought.

The burden laid upon the Interstate Commerce Commission to formulate a formal plan also is discarded by the Parker bill but must be reckoned with, as it will be published long before the bill is advanced toward enactment. E. I. Lewis, chairman of the commission, states that he is still hopeful that the consolidation plan will be ready by the beginning of the new year. The probability is that this plan will recommend the creation of a fifth trunk line system in Eastern territory comprising, among others, the Wabash, Lehigh Valley, Wheeling & Lake Erie, Pittsburgh & West Virginia and Western Maryland.

Whatever the recommendations of the commission, the existing trunk lines will not be called in for consultation prior to publication of the commission's plan. There is no prospect of agreement among them at this late date. Their proposals on grouping either may be modified later to conform in some respects with the commission's plan or they may present them with a plea for modification of that plan.

Hurley Succeeds Good

Officers in the Corps of Engineers and other branches of the army have expressed themselves as being particularly pleased with the selection of Patrick J. Hurley as Secretary of War, whose appointment was confirmed by the Senate on Dec. 9. It is pointed out that by virtue of his military experience in France during the War and his other services with the army he is unusually well qualified to take over the position. As Assistant Secretary of War, he has also gained valuable experience in the work of directing the affairs of the department.

Mr. Hurley is a native of Oklahoma, where he was born in 1883. In 1908 he received the degree of Bachelor of Law from the National University of Law at Washington. He was admitted to the bar of Oklahoma in 1908 and began practice at Tulsa. His military service began in 1902 when he was captain of cavalry of the Indian Territorial Volunteer Militia. During the World War he reached the grades of major and lieutenant-colonel. He is at present a colonel in the Officers' Reserve Corps. For his services during the World War he was awarded the Distinguished Service Medal.

Power Commission Changes

It is not believed that President Hoover's recommendation for the appointment of full-time members of the Federal Power Commission means that an independent agency is to be set up. Unless the water-power act is amended, all work must be done by and through the War, Interior and Agriculture departments. The whole conception of the water-power act is simply to provide a single agency in which the water-power responsibilities of the three departments can be co-ordinated. Without far-reaching changes, the full-time commissioners would have to be the representatives of the War, Interior and Agriculture departments. To comply with the President's suggestion, an assistant secretaryship could be authorized for the purpose. An alternative possibility is the detail of an engineer from the Corps of Engineers, the Bureau of Reclamation and the Forest Service to serve as members of the commission.

The Power Commission has undertaken a review of the areas withdrawn in connection with plans for water-power development. The survey is to determine what portions of those areas are actually needed for power purposes. It is regarded as important that early action be taken to vacate the areas that are not needed. This will allow homesteaders and others who have made entries on such lands to clear their titles. To expedite this work an early conference is to be held among the representatives of the various bureaus interested.

Public Lands Transfer Before Congress

Legislative backing to the President's program for turning over the remaining portion of the public domain to the states in which it is situated has been assured by Representative Colton, of Utah, chairman of the House public lands committee. He has introduced a bill authorizing the appointment of a Presidential commission of 25 members to investigate and report on the administration of the public domain. The Secretaries of Agriculture and Interior will be ex-officio members of the commission. An appropriation of $50,000 is provided to carry along the work.

Society Calendar

AMERICAN CONCRETE INSTITUTE, Detroit; annual convention, New Orleans, La., Feb. 11-13.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington; annual convention, Atlantic City, N. J., Jan. 11-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; annual meeting, New York City, Jan. 15-17.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago; annual meeting, Seattle, Wash., Jan. 28-30.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington; annual convention, New Orleans, La., Jan. 20-22.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, Trenton; annual convention, Syracuse, N. Y., Feb. 19-21.

NATIONAL CRUSHED STONE ASSOCIATION, Washington; annual convention, Cincinnati, Ohio, Jan. 20-23.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington; annual meeting, Memphis, Tenn., Jan. 28-30.

THE SIXTH INTERNATIONAL ROAD CONGRESS, to be held in Washington, D. C., Oct. 6-13, 1930, by invitation of the U. S. government, will be in charge of an American organizing commission under the authority of the State Department. Roy D. Chapin, chairman of the highways committee of the National Automobile Chamber of Commerce, is president of the commission and Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, is secretary-general.

RUSSIAN ASSOCIATION OF ENGINEERS, New York City, will hear its president, Leon S. Moisseiff, speak on "Impressions on Reconstruction in the U.S.S.R." on Dec. 17 in the Engineering Auditorium.

Obituary

GUY MOULTON, former state division engineer of canals and highways in the Central New York section, died suddenly on Dec. 3 from heart disease. Mr. Moulton was 65 years old. After his graduation from Cornell University in 1881, he did engineering work for the Lehigh Valley Railroad and later in the mines of Pennsylvania. In 1898 he joined the staff of the state engineer and surveyor of New York. He became division engineer under Frank M. Williams, state engineer, and was in charge of operations when the Barge Canal was built. Of late years he had been an engineering consultant.

WALLACE W. BRIGGS, since 1925 vice-president and general manager of the Grays Harbor Railway & Light Company, Aberdeen, Wash., died in that city Dec. 9. Mr. Briggs was well known in the West. For a number of years he was San Francisco district manager for the Westinghouse Electric & Manufacturing Company and later general manager of the Great Western Power Company of California. In 1918 he removed to the East to join the Westinghouse New York organization and subsequently became affiliated with the Federal Light & Traction Company, which controls the Grays Harbor company. Mr. Briggs was sent from New York to fill the Grays Harbor position. At the time of his death he was a member of executive committee of the Northwest Electric Light and Power Association.

ANTON SCHNEIDER, engineer in charge of construction of the East River tunnel, New York, died in Lakeland, Fla., on Nov. 28. He was 59 years old. Mr. Schneider went to Florida in 1908 as manager of a phosphate company and became the first city manager of Lakeland. He also held a similar post at Bartow, Fla.

EDWARD A. BOND, former state engineer and surveyor of New York, under whose direction plans for the State Barge Canal were prepared, died in New York City on Dec. 10. He was 80 years old. Mr. Bond began his engineering career with the Utica, Chenango & Susquehanna Railroad in 1868. Later he served other railroads in New York State. He became state engineer and surveyor in 1898 and held the post until 1904. During those years he had full charge of surveys, plans and estimates for the Barge Canal. While in office he foresaw the importance of flood prevention and stream measurement and, in co-operation with the federal government, began a system of measurements of the streams of the state. Mr. Bond was president of the Barrie (Ont.) Water Works Company, the Chatham (Ont.) Water Works Company and the Napenee (Ont.) Water Works Company. He was a member of the American Society of Civil Engineers and a consultant on engineering problems.

Construction Equipment and Materials

Large Steel Company Acquires Western Plants

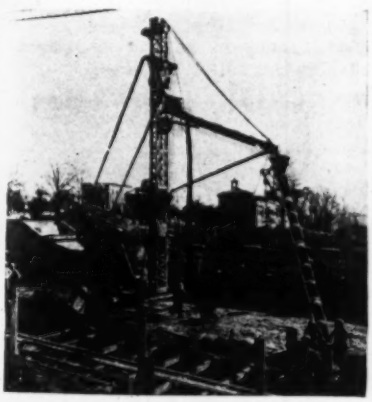
Purchase of the Pacific Coast Steel Company and its subsidiary, the Southern California Iron & Steel Company, by the Bethlehem Steel Corporation, has been announced by Eugene V. Grace, president of the Bethlehem Steel Corporation. The announcement follows only a month after the acquisition of the Columbia Steel Corporation, Pittsburgh, Calif., by the United States Steel Corporation. Properties of the Pacific Coast Steel Company and the Southern California Iron & Steel Company to be acquired include steel manufacturing plants in South San Francisco, Los Angeles and Seattle, Wash. The plants have steel ingot capacity of 380,000 gross tons a year, producing billets, merchant and reinforcing bars, light structural shapes, transmission towers, universal plates, light rails, tie plates, splice bars, forgings, bolts, nuts and rivets.

The properties to be acquired by the Bethlehem corporation will be operated through a separate subsidiary company with headquarters on the Pacific Coast, according to Mr. Grace's announcement. The name of the new company and its officers have not been made public.

New Developments

Folding Mast Attached to Paver

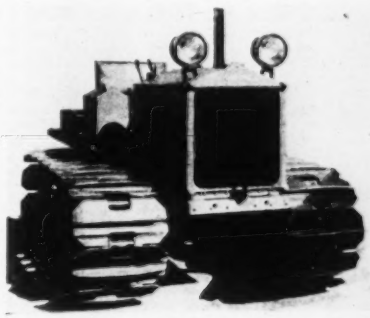
Use of a paving mixing for concreting retaining walls, foundations and similar jobs is greatly facilitated by a folding mast developed by the Ransome Concrete Machinery Company, Dunellen, N. J. This unit is hinged and can be folded down to travel under telephone wires, bridges and other obstructions. Raising or lowering the mast is accomplished by attaching it to the paver loading skip by means of pipe struts. In the upright position the same struts are fastened to the paver frame, making the entire unit self-supporting without the use of guys. A set of folding jacks is used to lend additional stability. Concrete is raised in a hoist bucket of 1-cu.yd. capacity raised by a hoist attached to the power plant. The control levers for the hoist and brake are located so that one man on the operator's platform can operate the mixer and mast bucket. When used in regular road work, the complete mast attachment is dismounted and a standard boom and bucket installed on the paver.



HINGED MAST AND CHUTE ATTACHED TO A STANDARD PAVER

Special Tractor Designed for Unusually Soft Ground

Working under extreme conditions of soft mud or sand is possible for the Cletrac swamp special, a new type of tractor developed by the Cleveland Tractor Company, Cleveland, Ohio. In general design this follows closely the standard model 30 Cletrac, the difference being found in the provisions made for the installation of unusually wide tracks with grouters attached. The tracks, 22 in. in width, have a ground length of 73 in., reducing unit pressure to 2.6 lb. per sq.in.



WIDE TRACK SUPPORTS TRACTOR IN SOFT GROUND

Boxes on Trucks Separate Cement From Aggregates

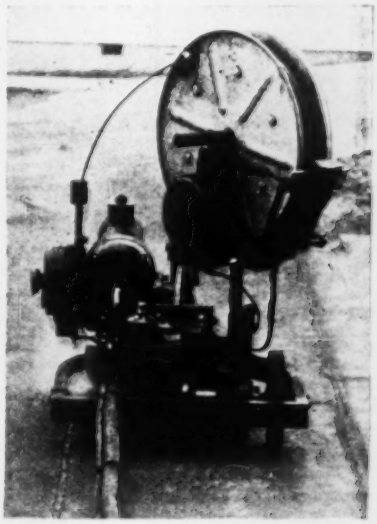
Saving in labor costs, the prevention of cement waste and greater ease in using bulk cement are the advantages gained from using a new type of cement box for attachment to trucks now being marketed by the George O. Harm Company, Warren, Ohio. The boxes are attached to trucks carrying aggregate to the mixer, and are filled either from sacks or from a bulk cement-handling plant after the truck has received its load of aggregate. Each box is mounted on two pivot pins and is held in an upright position by the flange of the lid, which also gives complete protection to the cement while in transit. When the trucks arrive at the mixer, the lid of the box is lifted slightly, allowing it to tilt slightly outward so that when the batch is released the box turns completely over, depositing the cement on top of the moving stream of aggregate. Thus the cement does not come into contact with the wet metal surface of the truck body or of the skip, eliminating the troublesome caking up of equipment so often experienced.

CEMENT BOXES ATTACHED TO TWO-BATCH TRUCK

The cement boxes are of very simple construction and are easily interchangeable over a wide variety of truck bodies. This makes it possible to attach them quickly to hired equipment and to remove them when the trucks are needed for other purposes. The standard size has an over-all length of 59½ in., a width of 13½ in. and a depth of 22⅝ in. and holds 8 cu.ft. of cement.

Machine Welds Battledeck Floors

For automatically welding steel floors the General Electric Company, Schenectady, N. Y., has developed a special electric arc-welding machine which was demonstrated at the recent convention of the American Institute of Steel Construction at Biloxi, Miss., where it welded steel plates to structural steel beams to make a new floor construction



AUTOMATIC WELDING OF STEEL FLOORS

known as the battledeck type. The machine itself consists of a three-wheeled, self-propelled vehicle driven by an adjustable-speed motor carrying a wire-feeding device, a reel of welding wire and control devices. It occupies a floor space of less than 5 sq.ft. with a height of 2 ft. Current, supplied by a welding generator through the trailing cable, serves not only for welding but also for operating the travel motor. Small rheostats are provided to regulate the speed of travel and the speed of welding wire feed, thus making it possible to operate to any particular set of circumstances. At Biloxi the machine operated at a speed of 9½ in. per minute.

In operation, the machine is placed at the beginning of a seam, where it is lined up and started. Any possible deviation from the seam during the course of travel can be corrected by means of a small steering wheel. When the end of a seam is reached the machine is turned around and placed on the beginning of the next seam, proceeding as before.

Unusual Rear Axle Used in 3-Ton Truck

Rear-axle drive of a unique type is used in the new model 50D truck recently announced by the Relay Motors Corporation, Lima, Ohio, and rated at

DUMP BODY ON 3-TON CHASSIS

2-, 2½- and 3-ton capacity. This axle, which was described in detail in *Engineering News-Record*, March 10, 1927, p. 426, carries the weight of body and load on pinions which engages ring gears on each rear wheel and which are free to move to a certain extent both vertically and horizontally, thus cushioning impacts and utilizing the weight of body and load to aid in propulsion. This type of axle has been in use for some time in the 1- and 1½-ton trucks manufactured by the same company.

Three wheelbase sizes are available in the larger unit: 139½, 161 and 185 in. Power is supplied by a six-cylinder engine, 3¾-in. bore and 5-in. stroke, with an S.A.E. rating of 33.75 hp. A forced-feed lubrication system is used. The transmission, of the selective sliding gear type, has five forward speeds and two reverse. Gears and shafts are of nickel steel, heat treated and ground. Service brakes are of the internal expansion hydraulic type operating on all four wheels, while the usual propeller shaft mounting is used for the hand brake. Pneumatic tires are standard equipment.

Costs and Contracts

E. N.-R. Index Numbers

Cost		Volume	
Dec. 1, 1929	**209.46**	**November, 1929**	**245**
Nov. 1, 1929	208.46	October, 1929	273
Dec. 1, 1928	210.16	November, 1928	251
Average, 1928	206.78	Average, 1928	287
Average, 1927	206.24	Average, 1927	263
1913.....	100.00	1913.....	100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Dec. 12, with some comparisons, total as follows:

(In Thousands of Dollars)

	Dec. 12, 1929	Dec. 5, 1929	Dec. 13 1928
Buildings:			
Industrial	$11,726	$7,233	$4,199
Commercial	12,740	29,189	14,677
Streets and roads	3,370	7,848	2,491
Other eng. constr.	7,645	13,879	30,420
Total	$35,481	$58,149	$51,787
Total, all classes, Jan. 1 to Dec. 12			
1929.....			$3,882,737
1928.....			3,491,129

Business Notes

GEORGE D. WHITCOMB COMPANY, Rochelle, Ill., has completed a new factory addition to be used primarily for the manufacture of large oil-electric and gear-driven locomotives.

YOUNG RADIATOR COMPANY, Racine, Wis., has plans under way to double its manufacturing capacity during the coming year.

HEIL COMPANY, Milwaukee, Wis., announces the appointment of C. N. Maurer as director of its highway sales division. For the past ten years Mr. Maurer has been connected with the Wisconsin State Highway Commission as traffic engineer.

MANGANESE STEEL FORGE COMPANY, INC., Philadelphia, Pa., has discontinued its office in Cleveland, Ohio. The Ohio territory will be handled from the Pittsburgh office, in charge of J. H. McKinley. P. M. Hobbs has been transferred from Cleveland to take charge of the Chicago office, and W. H. Potter, formerly manager of the Chicago office, has been made general sales manager of the company, with headquarters in Philadelphia.

MORITZ-BENNETT CORPORATION, Effingham, Ill., has been formed as successor to the Highway Shoulder Machine Company. Practically no changes have been made in the personnel and ownership of the new organization.

LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has placed R. B. Tuhey in charge of its Indianapolis office. S. H. Taylor has been made district representative at Los Angeles, Calif.

H. D. CONKEY & COMPANY, Mendota, Ill., has placed Charles M. Nuckolls in charge of design and development work in its crane department. Mr. Nuckolls has had previous experience with the International Harvester Company, the Whiting Corporation, and the Shaw Crane Works.

NORTHWESTERN PORTLAND CEMENT COMPANY, Seattle, Wash., which operates a cement plant at Grotto, Wash., has purchased a plant site on Maury Island for the purpose of erecting a sand and gravel factory. The plant will have capacity of 400 cu.yd. per hour.

DOLESE & SHEPHARD COMPANY, Chicago, Ill., has elected O. P. Chamberlain president. Mr. Chamberlain is a past-president of the Western Society of Engineers and for many years has been vice-president and general manager of the company.

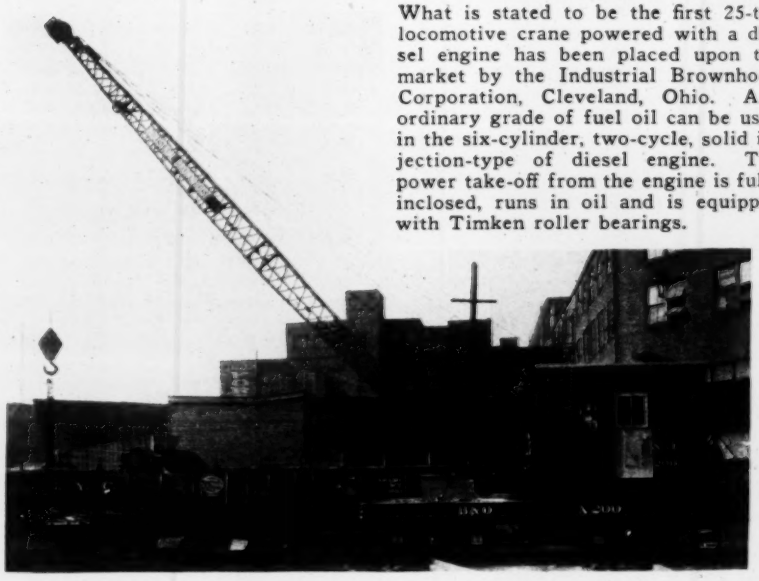
New Publications

Cement and Concrete—PORTLAND CEMENT ASSOCIATION, of Chicago, Ill., has issued a 64-p. general reference book containing information in regard to the cement industry, the manufacture of portland cement, uses of this product in concrete highways, and other data.

Pumps—CHICAGO PUMP COMPANY, Chicago, Ill., has issued a new 196-p. catalog of its products, including horizontal pumps, water-supply systems, bilge pumps and cellar drainers, eductors, condensation and vacuum pumps and control apparatus. Sixteen pages of useful information and tables are also included.

Bridges—STRAUSS ENGINEERING CORPORATION, Chicago, Ill., has published a 32-p. booklet, illustrated in color, describing a number of bridge structures designed and built by the company.

Steel—UNITED STATES STEEL CORPORATION, New York City, has issued a 51-p. booklet listing the products and publications of its subsidiary manufacturing companies, which include the American Bridge Company, the Carnegie Steel Company, the National Tube Company, the Canadian Bridge Company, Ltd., and the Universal Portland Cement Company.

DIESEL LOCOMOTIVE CRANE HAS 25-TON CAPACITY

What is stated to be the first 25-ton locomotive crane powered with a diesel engine has been placed upon the market by the Industrial Brownhoist Corporation, Cleveland, Ohio. Any ordinary grade of fuel oil can be used in the six-cylinder, two-cycle, solid injection-type of diesel engine. The power take-off from the engine is fully inclosed, runs in oil and is equipped with Timken roller bearings.